For engineers who design and manage the power and plant services

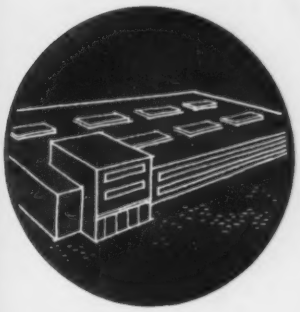
POWER

A McGRAW-HILL PUBLICATION

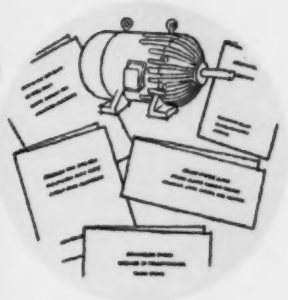
OCTOBER 1959

TWO DOLLARS

PLANT DESIGN ISSUE



Industrial Plant Design

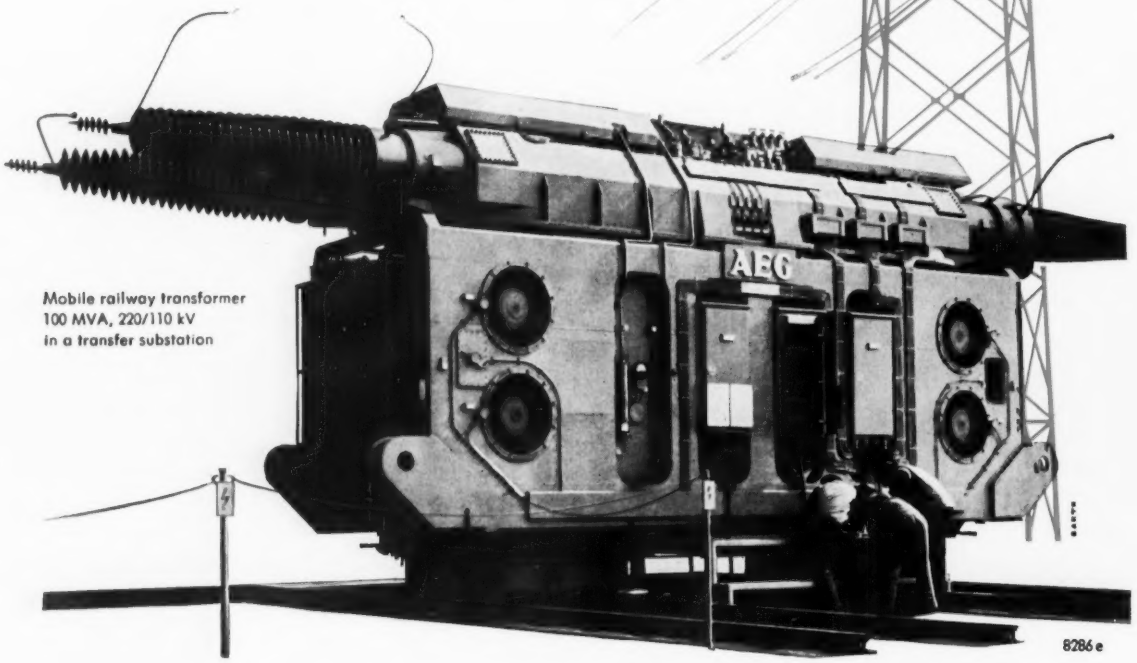


Equipment and Design Aids Roundup

Central Station Design

AEG

AEG have a long and extensive experience
in the manufacture of transformers
of all sizes and up to the highest voltages.
Three-phase generator transformers
rated for 220.000 V, 200.000 kVA,
with tap changing facilities and line transformers
220.000 kVA, 400.000 V
with a total bank capacity of 660.000 kVA
are amongst the world's largest.
The units are also built
with attached radiators as mobile railway types.



Mobile railway transformer
100 MVA, 220/110 kV
in a transfer substation

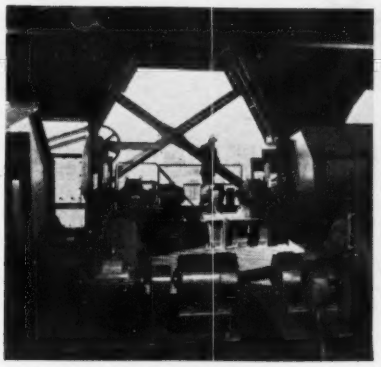
8286 e

ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT

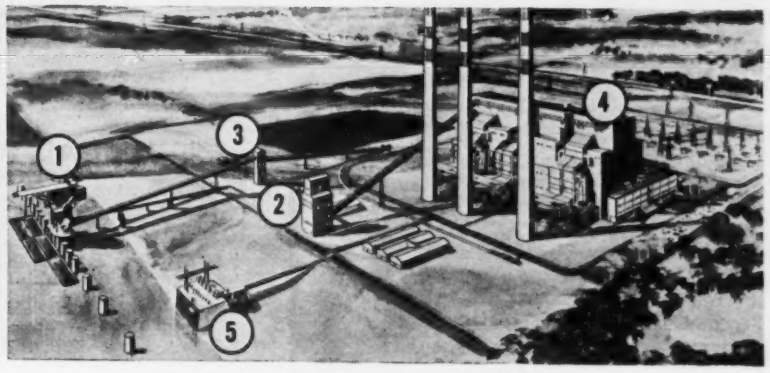
EXPORT DEPARTMENT BERLIN (WEST) FRANKFURT (MAIN)

For more facts circle 776 on Reader Service card, p 227

Directing traffic for 2200 tph



1. BARGE UNLOADING—Coal reclaimed by belt feeders is fed to two belt conveyors delivering to transfer tower where it may be directed to outside storage or bunkers.



LINK-BELT coal handling system adds to efficiency of Thos. H. Allen generating station at Memphis

At this new and highly efficient Memphis power station, designed by Burns and Roe, Inc., coal is carried from barge to storage to bunkers at capacities up to 2200 tons per hour. The entire system of Link-Belt coal handling conveyors is operated by one man from a central control panel.

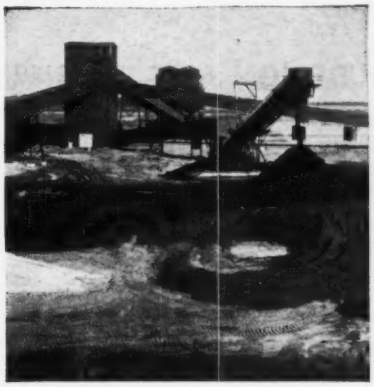
This huge Link-Belt coal handling network is a product of more than 80 years' experience. Before the advent of commercial electricity, Link-Belt was already establishing a reputation for efficient coal handling equipment in steam generating plants.

Today Link-Belt serves as a single source and responsibility for complete coal conveying systems or components . . . for both central stations and boiler houses. For details, write to Link-Belt Company, Dept. AV, Prudential Plaza, Chicago 1, Ill. Ask for Book 2410. It shows the latest in layouts and equipment for power plants, large and small.

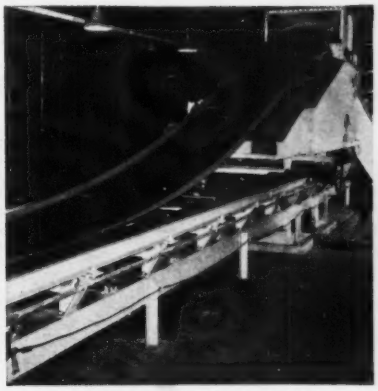
2. COAL CONVEYING—Two Link-Belt 48-in. wide inclined belt conveyors route coal to crusher. Each has a capacity of 1100 tph at speeds of 485 fpm.

LINK-BELT

One source . . . one responsibility for materials handling, processing and power transmission equipment 15,173



3. STOCKPILING is accomplished by the Link-Belt movable and stationary stackers. Both are equipped with Link-Belt 60-in. wide conveyor belts.



4. BUNKER LOADING—Two Link-Belt 48-in. bunker conveyors are equipped with trippers to distribute coal to bunkers at the rate of 1100 tons per hour.

5. SCREENING—Link-Belt bar screen in water intake pump house protects pumps and other equipment from debris, cleans water for condenser cooling.

For more facts circle 779 on Reader Service card, p 227

Power Plant Design Issue

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INDUSTRIAL PLANT DESIGN

A plan for growth can be spotted in many of the plant services reported in this issue. And, for the second year, industrials show a continuing preference toward self-ownership of their main substations

CENTRAL STATION DESIGN

Super pressures, nuclear power, and peaking-power supply continue as prime interests for the utilities. Take note of the nuclear plant listing on p 190 of the survey

EQUIPMENT and DESIGN AIDS ROUNDUP

Here are the latest in new products, bulletins and useful catalogs

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VOL. 103 • NO. 10 • TWO DOLLARS • OCTOBER 1959

Editorial: Plant design, 1959 — 75

79

New ways to make in-plant power generation pay for you — 80
H-t thermal liquids at low pressures step up industrial processing pace — 86
Now comfort cooling bids for the role of a major industrial power service — 87
How dependable main substations channel electric power to industry — 92
New instruments and controls speed full automation — 101
Industry looks at new waste-treatment developments — 102
New concept aims at low-cost power: jet engine and industrial gas turbine combine — 104
Industrial-plant design survey — 105
Design features of electrical systems — 106
Steam generation: small boilers gain — 111
Air conditioning: industrials are on the upswing — 120

163

Supercritical pressure pilot plant yields design data and mwhr — 164
Today's control systems stress operating safety — 167
Nuclear power plants undergo an intensive testing period — 170
Power generation for the distant future begins to take shape — 176
High-efficiency power systems should consider low-cost peaking plants — 178
Central-station design survey — 179
Central-station trends and typical new stations — 180
Roundup of stationary nuclear power plants — 190

229

Use Reader Service card for data on products, design aids, advertisements — 227
Clip this selection of recent books for the plant-service designer — 227A

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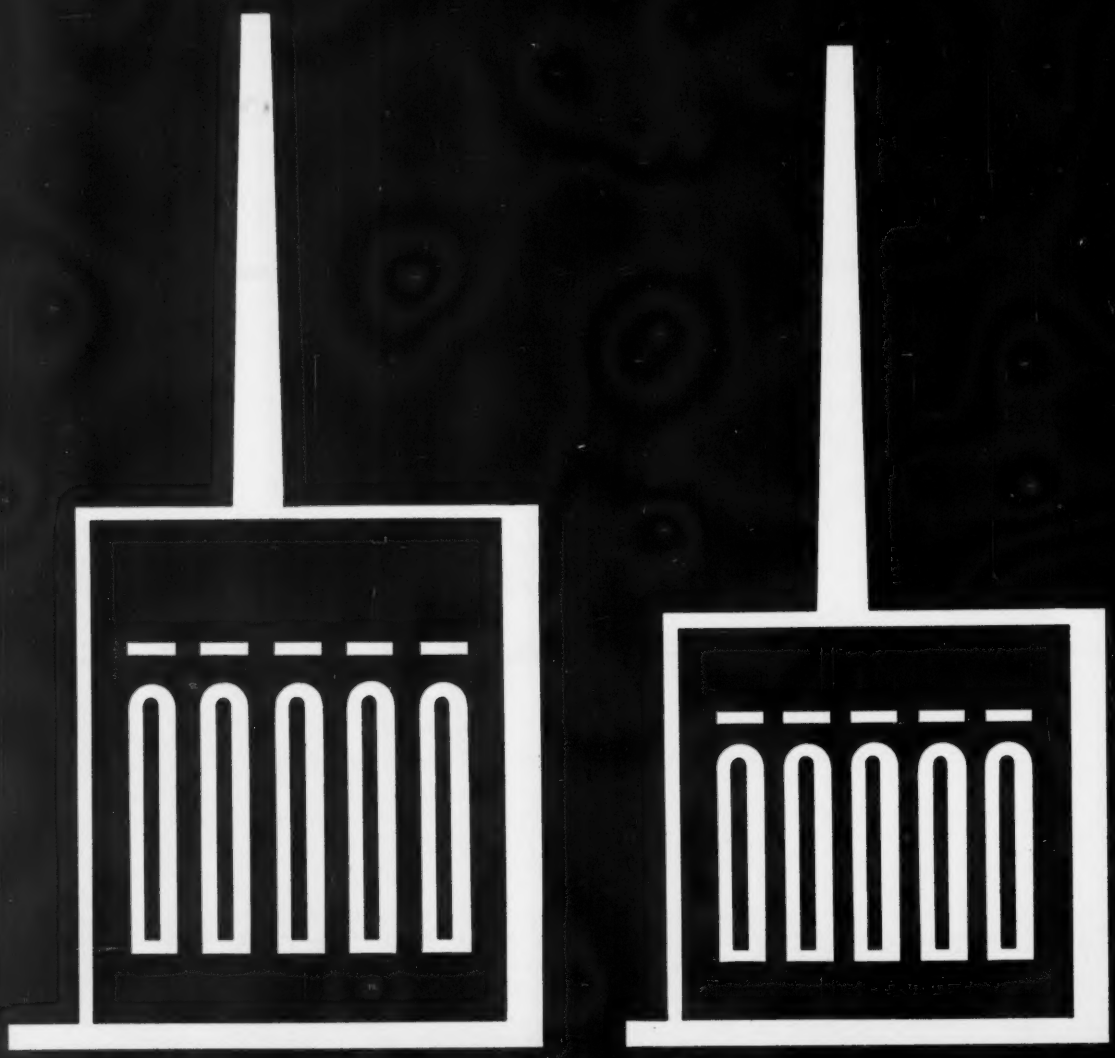
Gas Tempering: **Report No. 3**

Electric Utilities Cut Costs With



Over-All Plant Gas Tempering

...Smaller Buildings Per KW
...Less Structural Steel
...Lighter Foundations
...Shorter Steam Leads

Historically, the size of steam generating equipment has been based on two main considerations: space needed to burn fuel, and surface required to cool gases before they reach the convection surface. Boiler designers have long known that to cool the gases, they had to use furnaces much larger than required if complete combustion of the fuel were the only consideration. Now with the proved-in-operation principle of Gas Tempering, the surface requirements to cool furnace exit gases are substantially less.

What is Gas Tempering? . . . it is the reintroduction of cool flue gases near the furnace outlet to control the temperature of the furnace gases entering the convection surface.

From The Foundation Up, Electric Utilities are finding B&W Gas Tempering the most effective method of controlling temperatures of gases leaving the furnace . . . with a unit that is designed for minimum weight, height and bulk.

Definitive Booklet: If you'd like to learn more about the economies and design flexibility available to you through Gas Tempering, write for Bulletin G-96. Address: The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

Major Advantages of B&W Gas Tempering

. . . It cuts overall plant costs because the smaller size unit requires a smaller building per kw, a lighter foundation, less structural steel and shorter steam leads.

. . . It enables you to utilize the most economical available fuels. It permits the burning of a variety of coals without slagging, minimizes external corrosion of superheater tubes, and assures safe metal temperature, thus prolonging tube life, regardless of the fuel fired.

. . . It provides safe superheater tube temperature by positive gas temperature control; it protects superheater during startup and under all operating conditions.

. . . It makes it safer to design for economies offered by operation at steam temperatures of 1050 F and above.

B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

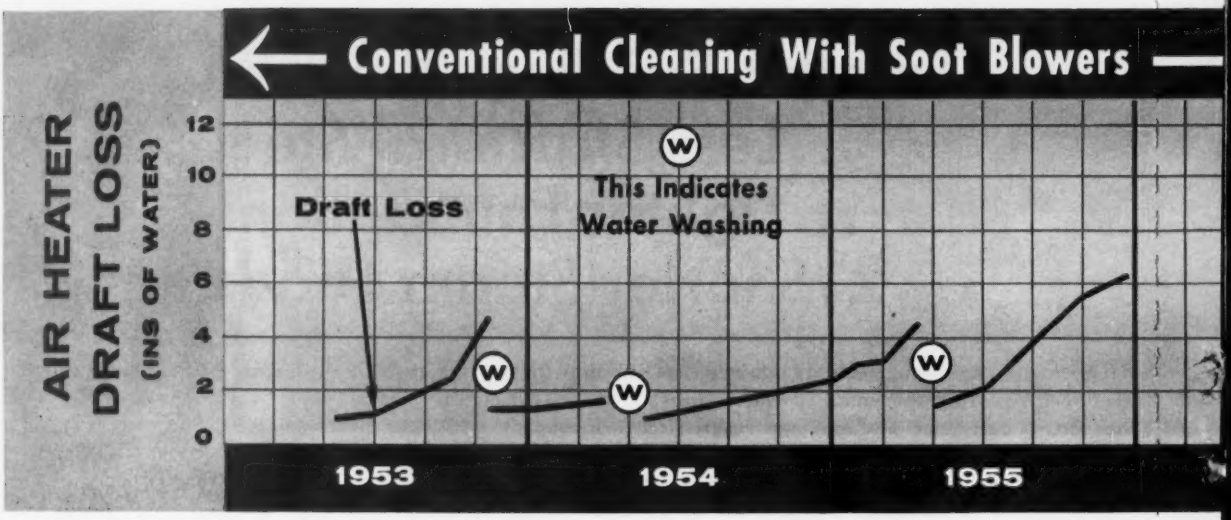
G-933

For more facts circle 780 on Reader Service card, p 227

DIAMOND

Keeps TUBULAR AIR

That Could Not



Here is an example of how Diamond Shot Cleaning solves certain cleaning problems previously impossible of solution.

The chart shows increase in draft loss across a tubular air heater resulting from ineffective soot blower cleaning. Mounting draft loss caused decrease in fan capacity and reduction in load. During the first four years of operation it was necessary to water wash this air heater six times (at "W"). Each washing required a three day outage of the boiler.

Diamond Shot Cleaning was installed in September 1957. Since then draft loss has been minimum and uniform. Water washing with consequent boiler outage has been eliminated entirely.

This first installation was so successful that a second air heater was equipped with shot cleaning in 1958.

Diamond Shot Cleaning uses falling shot to clean horizontal tube surfaces such as superheaters, reheaters and economizers, as well as tubular air heaters. The shot is cascaded over the horizontal tubes or through vertical air heater tubes by distributors and scours the surfaces as it falls. Deposits are removed in small particles most of which are carried away by the gas stream. Heavier particles fall into the hopper and recirculate with the shot until broken fine enough to be picked up by the gases. Cleaning is thorough even with difficult fouling such as is found in black liquor fired boilers. Areas which tend to foul rapidly can be kept completely clean by increasing the automatic shot cycle (it may be continuous if necessary) without disturbing boiler operation.

In line with our half century policy of providing the best in boiler cleaning, Diamond has conducted extensive research on shot cleaning over a period of years. More than 30 installations are now in successful operation in United States . . . some of them since 1954. To supplement this program, Diamond has acquired the U. S. rights to the Broman-Ekstrom system, of which there are more than 800 successful installations in Europe.

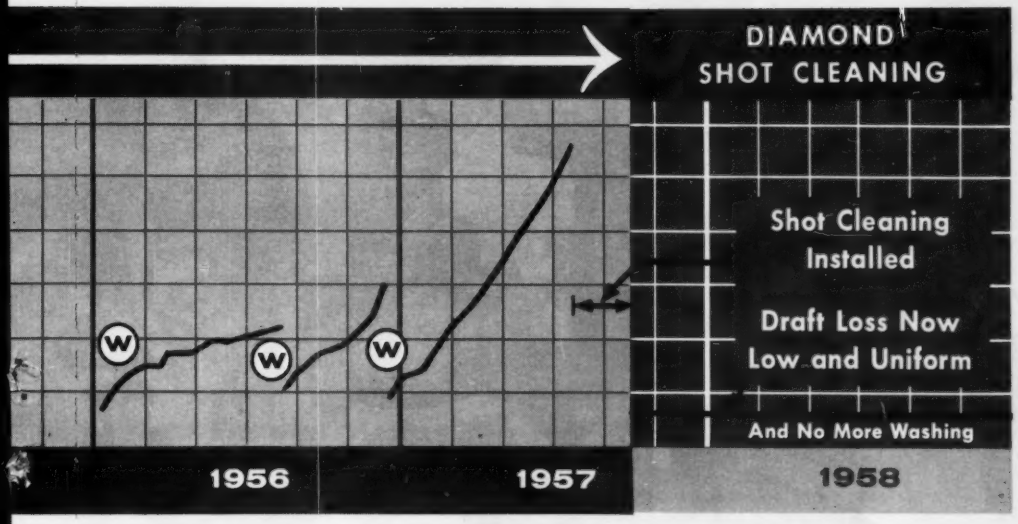
DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO

Shot Cleaning

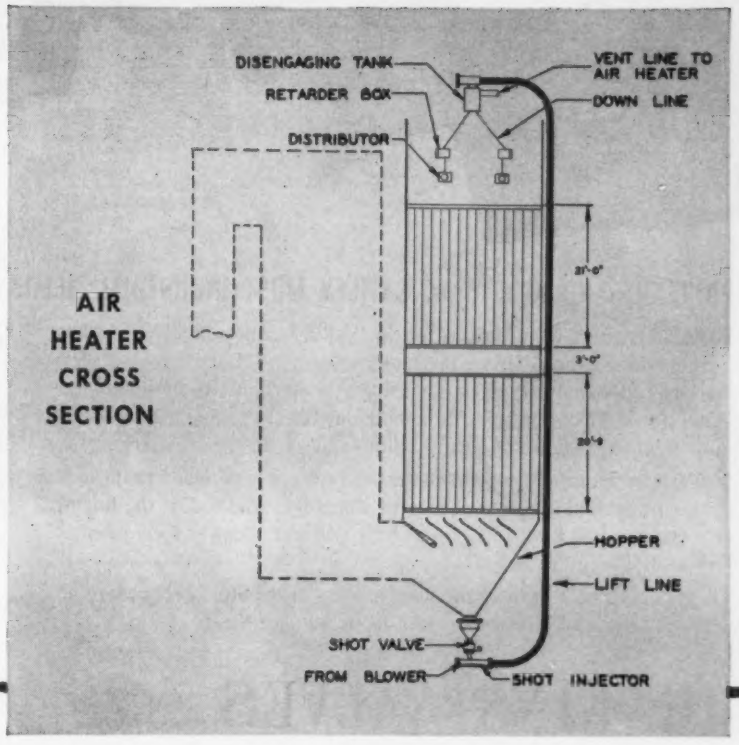
HEATERS CLEAN

be CLEANED BEFORE



WRITE FOR BULLETIN 2145 ON DIAMOND SHOT CLEANING

It has complete information, including data on shot lifting methods. For better boiler cleaning at lower cost, the answer always is Diamond.



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It's a good feeling to see

on your **STAINLESS**

PATTERNS AND ALLOYS TO SATISFY MOST INDUSTRIAL NEEDS

For solid reasons, men who ask for the best in Stainless Steel Valves have full confidence when they see the Jenkins Diamond. For almost a century this mark has appeared only on valves made to peak standards of quality in design . . . in castings . . . in machining. JENKINS standards, enforced by the most rigid inspection and testing in the valve industry.

Valves of corrosion resistant stainless steels have been made to those high standards by Jenkins for a quarter of a century. And today, the line of Jenkins Stainless Steel valves includes types and alloys to fully satisfy most service requirements.

They are available through the same leading distributors everywhere who sell Jenkins Valves of Bronze, Iron and Cast Steel.

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☐ Have a representative call on me

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COMPANY.....

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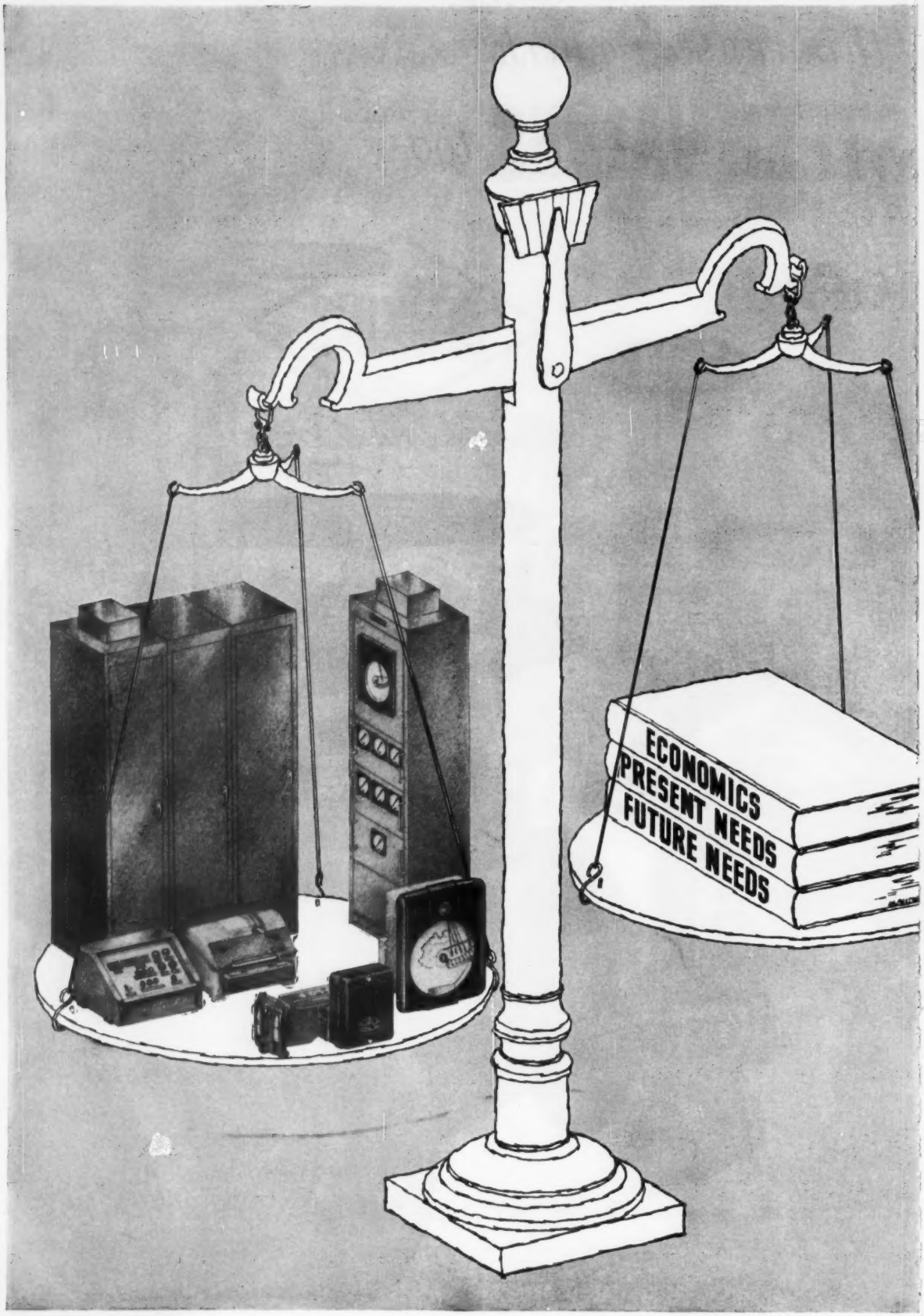
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PRESENT NEEDS
FUTURE NEEDS

BAILEY

BALANCES ALL THESE FACTORS TO HELP YOU REACH OPTIMUM PERFORMANCE

Bailey takes a sensible systems approach by analyzing the immediate and future needs as well as the control economics of your complete process.

Backed by 40 years' experience in the field of measurement and control, Bailey engineers can insure that your system will have the proper balance both as to economics and needs . . . that there will not be the unnecessary expense of over-instrumentation or control . . . nor the duplication of equipment functions.

To effect this approach, Bailey offers a complete line of process and power system components:

Equipment—Primary sensing devices, indicators, recorders, loggers, control units, panels, data-handling equipment and computers for performance analysis, and supervisory controls.

State-of-the-Art—Conventional and sophisticated designs ranging from mechanical, pneumatic and electric thru electronic and solid-state.

Because all of these components are *standardized and compatible*, you have building block flexibility. You can add to your system as the need arises for more control or analysis.

Our complete line gives you one-source buying . . . one responsibility . . . qualified systems engineering . . . fast service . . . experienced field assistance on one instrument or on a complete system. Call our nearest office or write for information today.

G150-2

Instruments and controls for power and process

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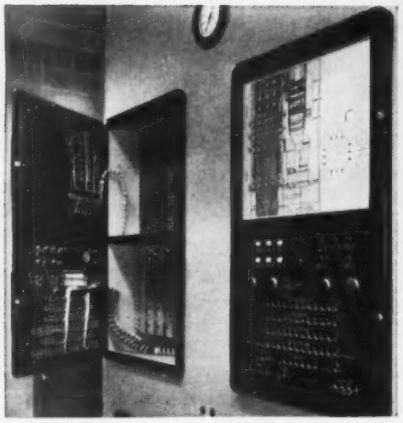
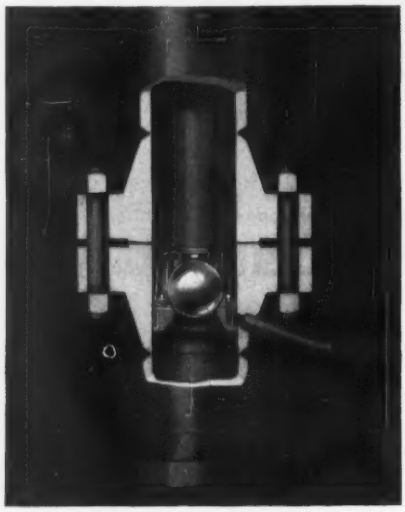
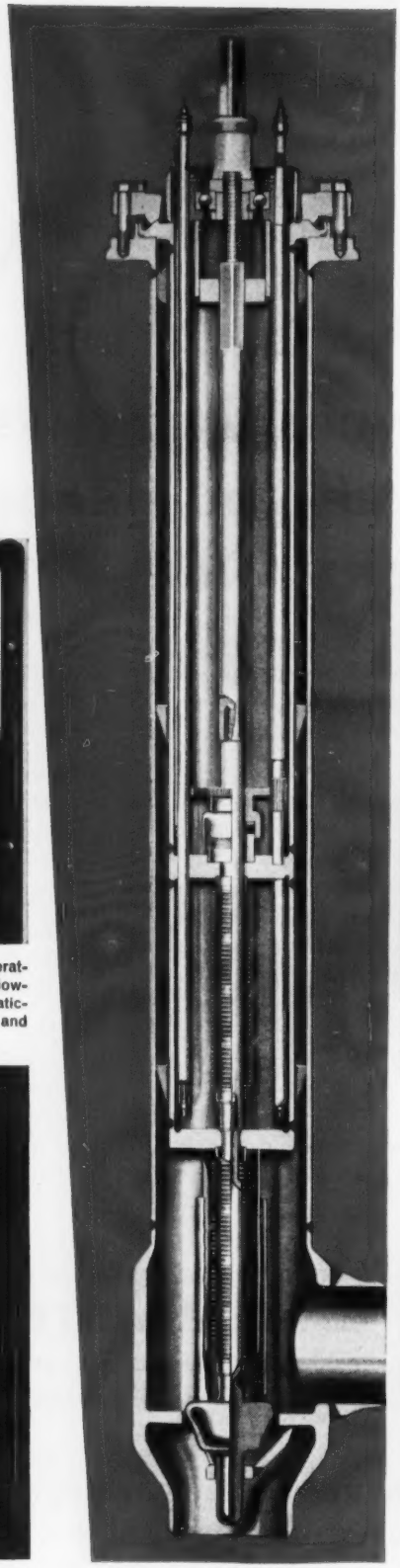
Nuclear with



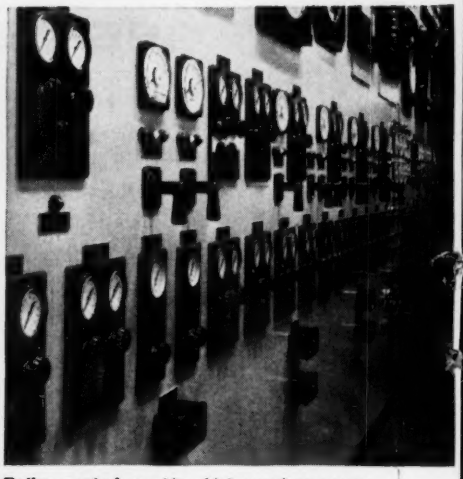
Automatic soot blowing permits varying the operating sequence of air- or electrically-driven soot blowers. Vulcan Selective-Sequence and Automatic-Sequential systems assure positive cleaning, and save blowing medium. Write for Bulletin 1029.



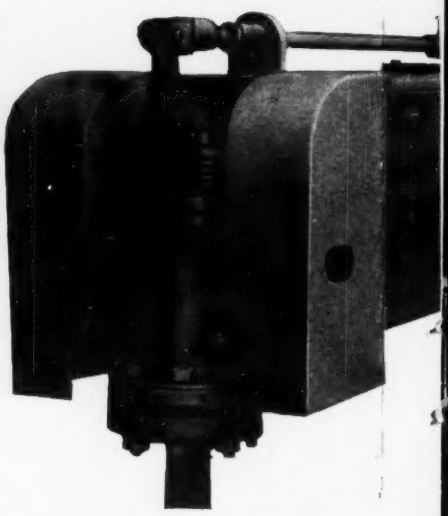
Variable-Orifice Desuperheater* holds reduced steam temperature constant close to its outlet. Write for Bulletin 1037. Carburetor and Steam-Assist types are also available for steam service conditions through 2500 psig and 1100 F. **Patent applied for.*



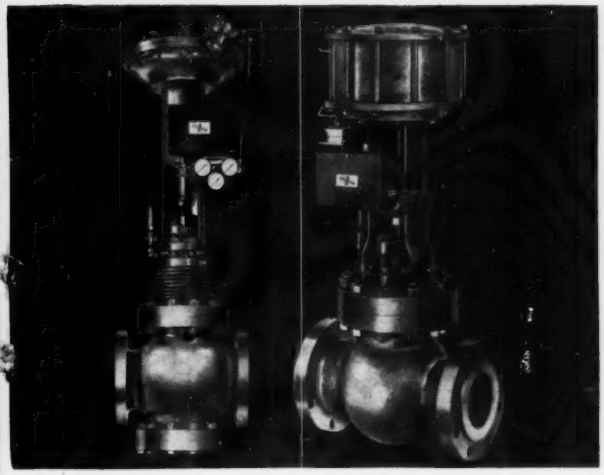
Nuclear valves meet rigid requirements for resistance to corrosion, fail-safe operation, and remote maintenance. Components are thoroughly cleaned and assembled in a sterile atmosphere.



Boiler control provides high-speed response. Combustion control may be from steam flow—air flow, or fuel-air ratio. Feedwater control from one, two, or three influences. Write for Bulletin 1038.



and fossil-fuel plants power up Copes-Vulcan equipment



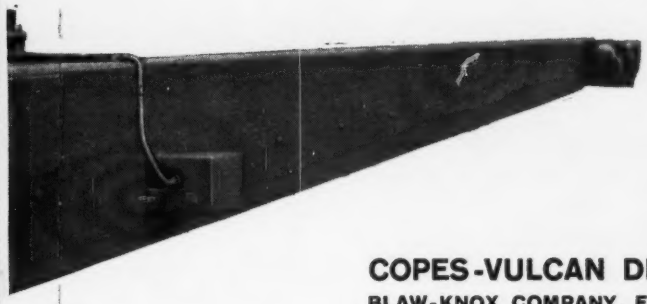
Control valves for flow, pressure, and temperature of fluids or gases are job-tailored for accuracy and dependability. Diaphragm- or piston-operated types are available in pressure standards from 125 through 2500 psig. Both offer excellent rangeability. Write for Bulletin 1027.

In conventional, super-critical, and nuclear power stations on land . . . aboard conventional and nuclear-powered ships at sea, Copes-Vulcan precision-built control systems increase efficiency.

Meeting exact design requirements, Copes-Vulcan builds control systems for combustion, feedwater, superheat and reheat steam temperatures, pressure reducing, desuperheating, and soot blowing.

Copes-Vulcan is also experienced in the design and manufacture of such special products as nuclear valves.

All of these systems are custom-engineered. All are backed by more than 50 years of design experience.



Extra-long soot blower, Vulcan T-30, is built for travels up to 40 feet. Dual-motor drive gives multi-helix blowing pattern for thorough cleaning of all surfaces. All working parts encased for protection. Write for Bulletin 1030.

COPES-VULCAN DIVISION
BLAW-KNOX COMPANY, ERIE 4, PA.

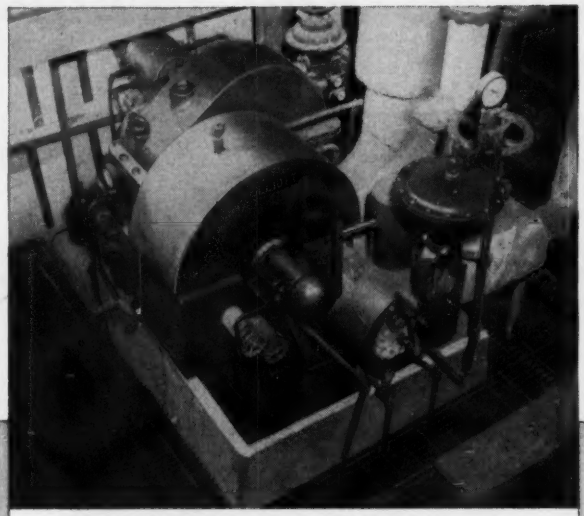
COPES VULCAN

BLAW-KNOX

ELLIOTT TURBINES
since nineteen hundred four
MOTORS
since eighteen hundred eighty eight

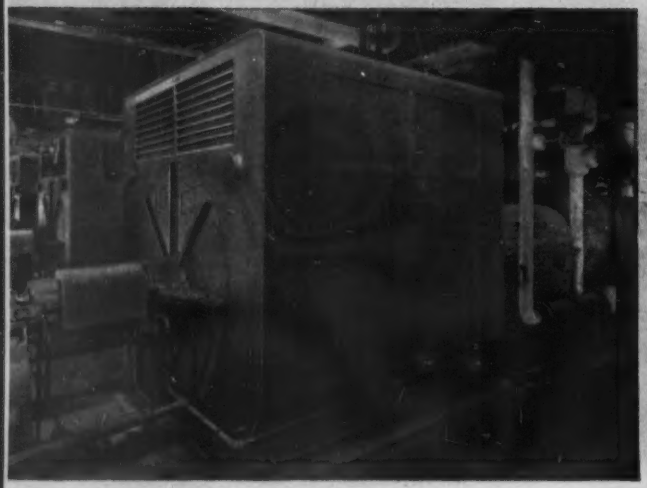
for your auxiliary drives...

Steam or Electric
Large or Small
Indoor or Outdoor

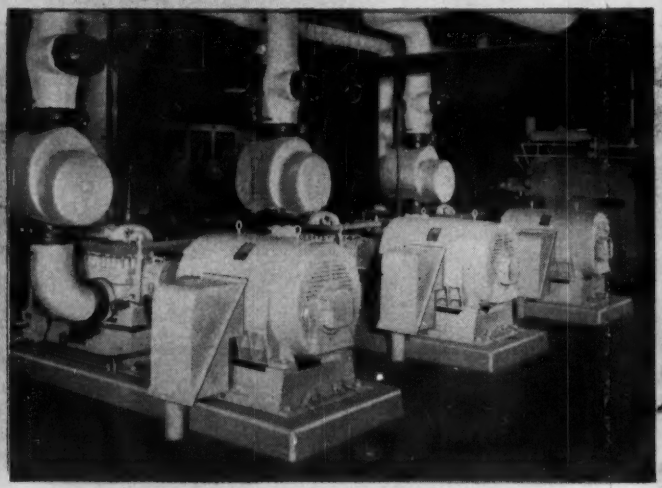


This Elliott geared turbine drives the induced-draft fan serving the 120,000-lb-per-hr boiler for a northeastern pulp mill. Elliott turbines are noted for simplicity, flexibility and year-in and year-out dependability.

ELLIOTT Company
JEANNETTE, PENNSYLVANIA

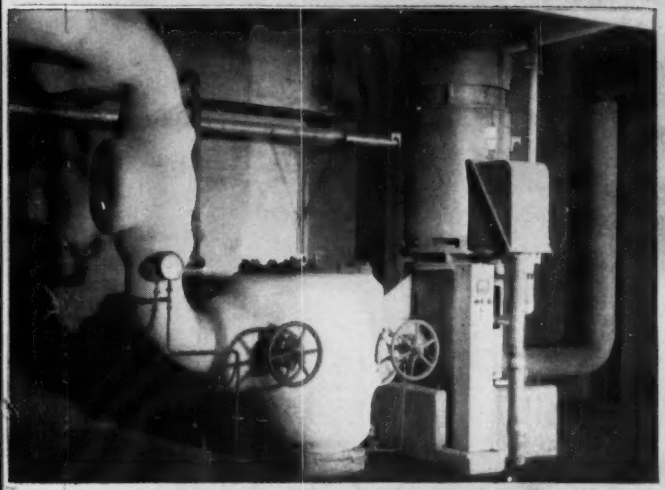


Biggest boiler-feed pump motors in the country—each rated 5000 hp at 3600 rpm. Quick-access openings visible on near end of motor; removable swing-down filter panels on each side. Elliott "Super-Quiet" enclosures. 6000-hp Elliott motors will soon be operating.

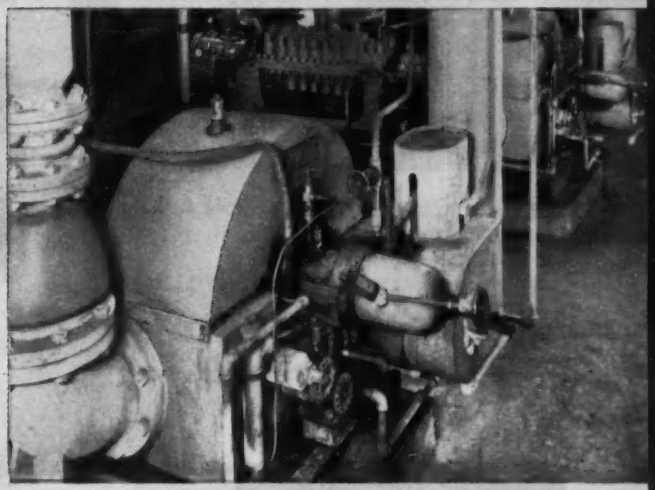


Heater drain pumps are driven by identical 200-hp, 3600-rpm Elliott motors. Elliott water strainers are mounted in pump inlets. Other Elliott products for power plants include condensers, ejectors, deaerating heaters, tube cleaners and expanders.

Dripproof 600-hp, 900-rpm Elliott motors driving line of coal pulverizers. Elliott FABRI-STEEL construction assures structural rigidity; FABRI-SEAL insulation assures maximum service life.



Here an Elliott 250-hp vertical, dripproof motor is shown driving a condensate pump. An Elliott twin basket water strainer which protects the pump can be seen at the left. Elliott C-W motor experience dates from 1888.



250-hp, 3550-rpm Elliott turbines drive boiler feeders in this industrial plant. All major auxiliaries in this station are Elliott turbine-driven. For over a half century, Elliott has been building turbines and turbine-generators.

What are your needs for

YARWAY COLOR-PORT WATER LEVEL GAGE

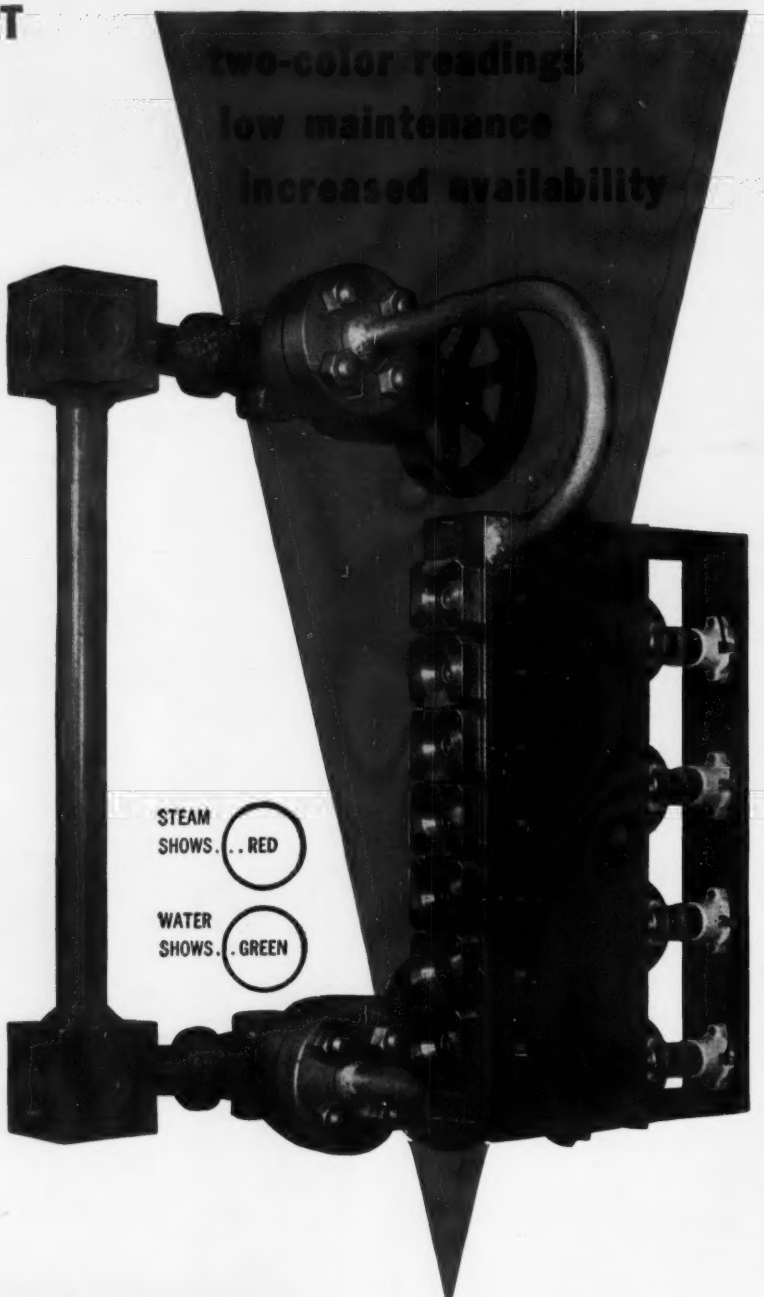
two-color readings
low maintenance
increased availability

You get a *triple advantage* with the Yarway COLOR-PORT boiler water level gage for pressures to 3000 psi.

Two-color readings are brilliant and clear. Water shows green; steam shows red. A full gage is all green and an empty gage all red.

Low maintenance with individual cover-glass assemblies, each held solidly in place by four socket head cap screws. "Floating assembly" design applies safe, predetermined loads on glass ports, reducing thermal shocks, permitting faster warm-up.

Increased availability means longer service life. Cover glass assemblies can be *serviced in place*, easily and quickly.



Yarway Bulletin WG-1814 describes the Color-Port Gage. Write for it.

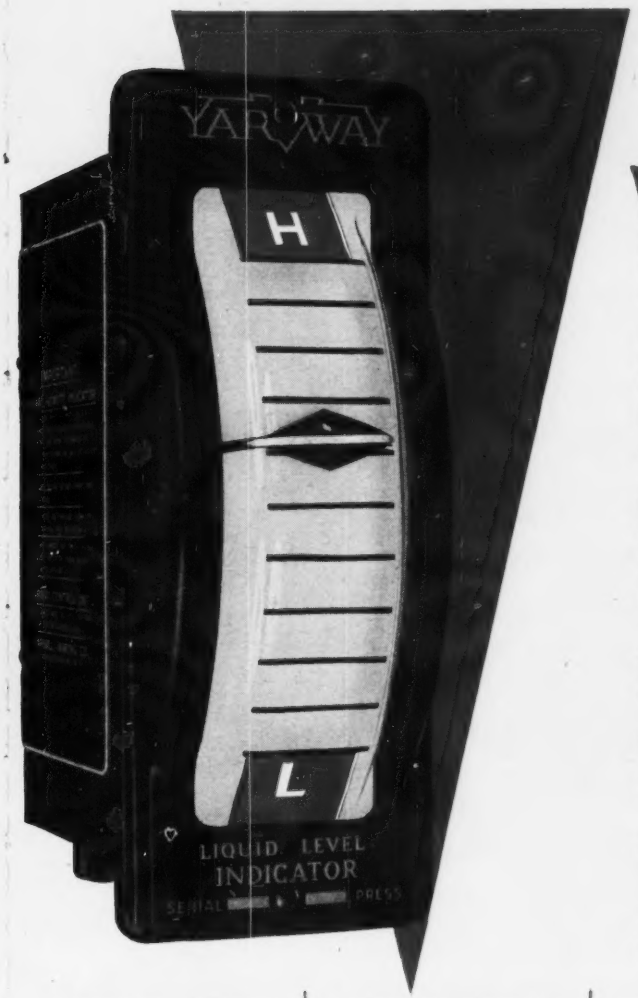
YARNALL-WARING COMPANY
100 Mermaid Avenue
Philadelphia 18, Pa.
Branch Offices in Principal Cities

YARWAY COLOR-PORT

. . . a good way to specify high pressure water gages

◀ Circle 785 on Reader Service card for preceding ad

boiler water level indication ?



YARWAY REMOTE LIQUID LEVEL INDICATORS

Boiler water levels and other liquid levels requiring remote indication can be handled completely by a Yarway system.

Heart of the system is the Yarway Remote Liquid Level Indicator that gives instant, accurate readings because the mechanism is operated by the boiler water or other liquid itself. The pointer mechanism is never under pressure. Clear, "wide vision" face permits easy readings from any angle.

The Yarway Indicator conforms with A.S.M.E. Boiler Code Committee ruling (Case #1155) permitting two independent remote level indicators of compensated manometric type to replace one of two required gage glasses for boiler pressures 900 psi and above.

Electronic Secondary Indicators can be added at any point in the plant. Remote Hi-Lo Alarm Signals (lights and/or horns) can be connected for additional safety.

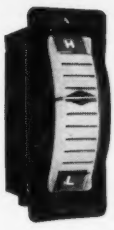
Primary indicators fully compensated for every pressure change in boiler also available.

For permanent record of changing levels, the Yarway Hi-Lo-Graph Recorder can be furnished.

Over 10,000 Yarway Remote Indicators have already been installed. For full details, write for Yarway Bulletin WG-1824.

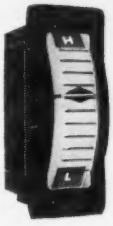
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities

FULLY COMPENSATED INDICATORS



for completely accurate indication under every boiler operating condition

ELECTRONIC SECONDARY INDICATORS



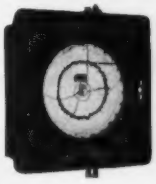
To supply additional indication at any point without pressure connections.

REMOTE SIGNALS

Hi-Lo Alarms Lights and/or Horns.

RECORDERS

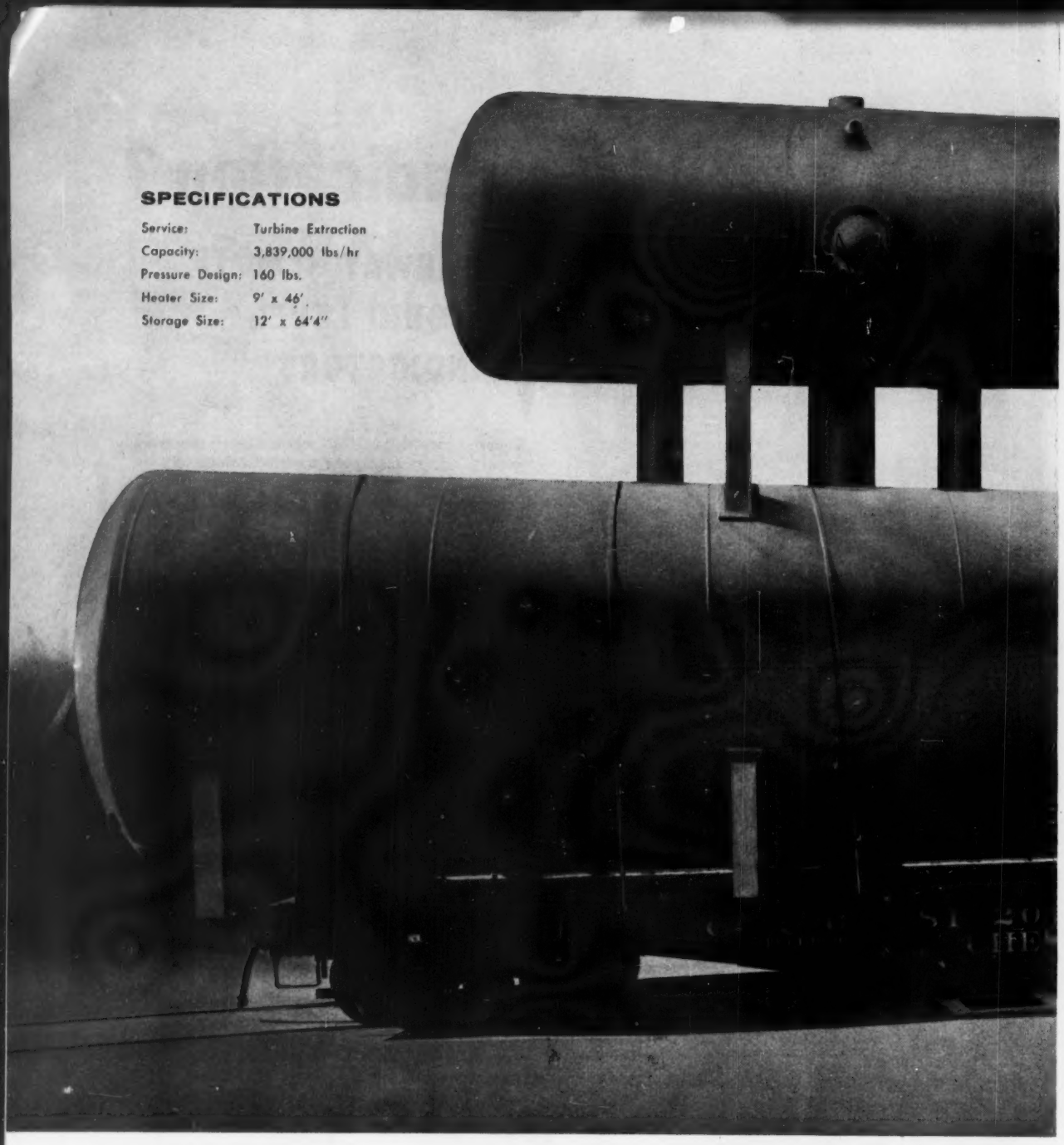
To provide permanent 24-hour record of liquid levels.



YARWAY

. . . a good way to specify remote liquid level indicators

For more facts circle 786 on Reader Service card, p 227



SPECIFICATIONS

Service:	Turbine Extraction
Capacity:	3,839,000 lbs/hr
Pressure Design:	160 lbs.
Heater Size:	9′ x 46′.
Storage Size:	12′ x 64′4″

It took 96 years to build this Giant

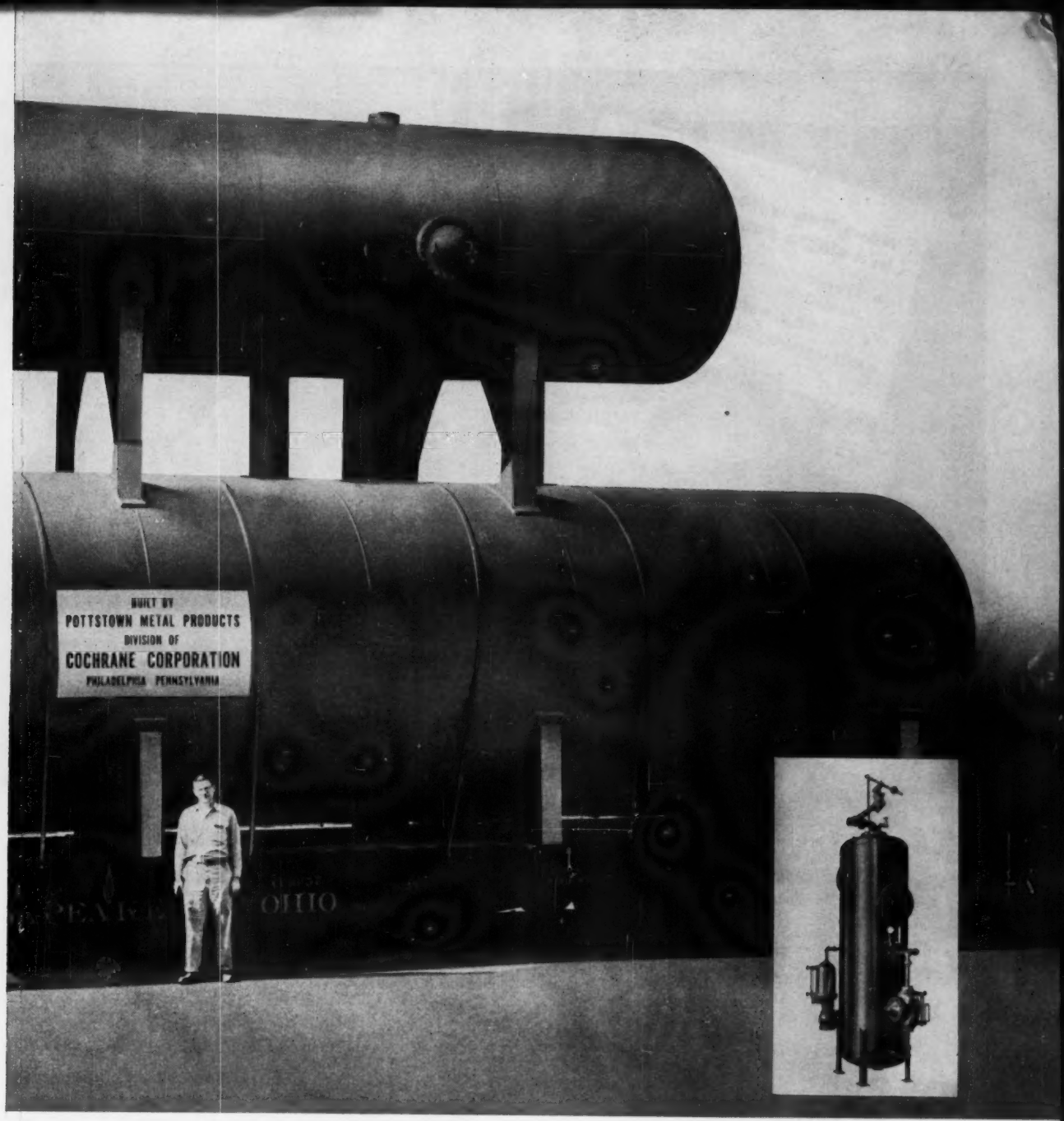
Ordered April 1958, delivered May 1959, the engineering background that made possible the design and fabrication of this gigantic unit has kept Cochrane foremost in its field for 96 years.

This 3,839,000 lbs/hr deaerator is designed for turbine extraction service in a public utility. An important contract requirement was an integrated tank shop capable of fabricating the shells to rigid specifications.

Cochrane pioneered in heater design and manufacture and today has the largest number of installations in the world. This background is your assurance that *guarantees will be met.*

Your requirements in deaerators, whether a small standard model or giant, can be solved readily by calling in a Cochrane engineer. Why not write today for the deaerator series bulletins . . . please specify the type in which you are interested.

For more facts circle 787 on Reader Service card, p 227



Deaerating Heater!

MIDGETS OR GIANTS

From the giant deaerator with its 12' x 64'4" storage tank above down to a 3' x 8' Unipac standard model, shown in comparable size in inset, there is no compromise in Cochrane's engineering and fabricating standards.

Cochrane

CORPORATION

3106 N. 17th Street, Philadelphia 32, Pa.

Philadelphia • New York • Chicago

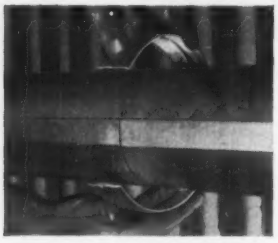
Cochrane Water Conditioning Ltd., Toronto 4; Montreal 1; Winnipeg 1, Canada

Representatives in 30 principal cities in U.S.: also Havana, Cuba; San Juan, Puerto Rico; Paris, France; La Spezia, Italy; Mexico City, Mexico; Caracas, Venezuela; Santiago, Chile; Honolulu, Hawaii.

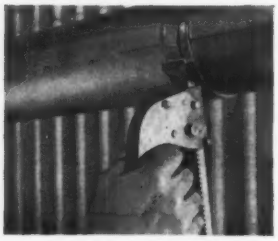
POTTSTOWN METAL PRODUCTS DIV.—Custom built carbon steel and alloy products.

Demineralizers • Zeolite Softeners • Hot Process Softeners • Hot Lime Zeolite Softeners • Dealkalizers • Reactors • Deaerators • Pressure Filters
Continuous Blowoff Systems • Condensate Return Systems • Steam Specialties

Remove from carton and Metal-On is ready to install. Just snap on pipe and lock in place.



...the specially designed aluminum "snap strap" (containing vapor seal) is snapped on joint...



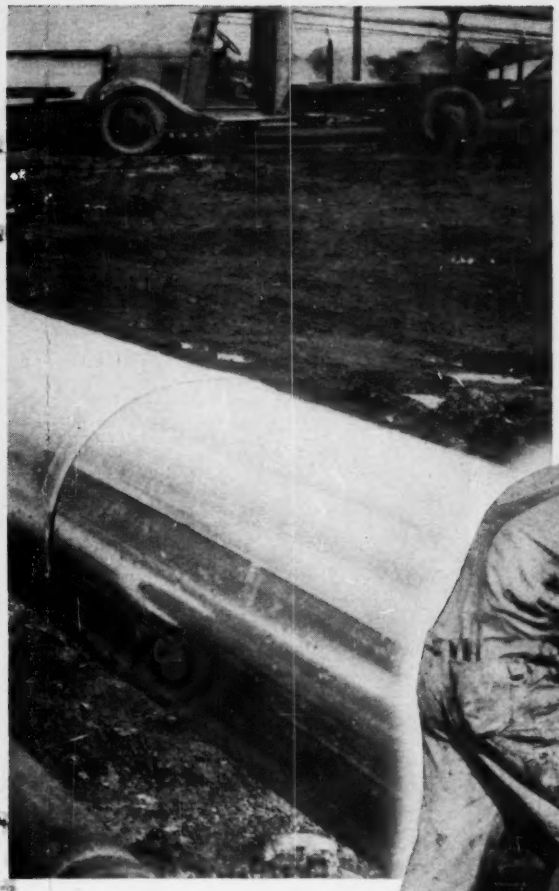
... Metal band completes the assembly ... provides perfect joint protection against vapor and weather. Available in many colors, the Metal-On band also serves color coding purposes.

Two men completed 660′ Metal-On

New Johns-Manville Metal-On insulation is today's fastest and most efficient way to install high-temperature pipe insulation... and protective metal jacketing

Metal-On is still new! It is just months since its introduction—yet it has already been accepted by virtually every industry in which high-temperature pipe insulation needs protective metal jacketing.

One reason for this rapid, all-out acceptance is Metal-On's installation economy. A single package product that consists of high-temperature insulation and protective aluminum jacket—Metal-On entirely eliminates separate on-the-job metal application. In



Part of 2100-foot Metal-On installation. New plywood plant of the Winton Lumber Co., Jackson, Cal. Insulation Contractor: Western Asbestos Co., San Francisco.

Metal-On pipe insulation presents no fitting problem. It is cut easily right on the job with either power or hacksaws. Available in long, 3-foot sections in a complete range of pipe sizes through 24" . . . by 3" thickness.

this insulation job in one working day!

fact—a section of Metal-On can be applied at least as fast as pipe insulation alone.

However important installation speed may be, it is but one Metal-On advantage! For Metal-On also ends guesswork in specifying aluminum alloys and jacket thicknesses. Its jacket measures an ideal .016" thick . . . of a high-quality aluminum alloy selected expressly for superior weather resistance . . . good appearance . . . and resistance to abuse and pitting.

Of course, Metal-On never needs painting. Won't rust. Is impervious to dirt, oils and grime. And, unlike corrugated metal jacketing, Metal-On has no dirt-collecting grooves—its smooth surface stays clean.

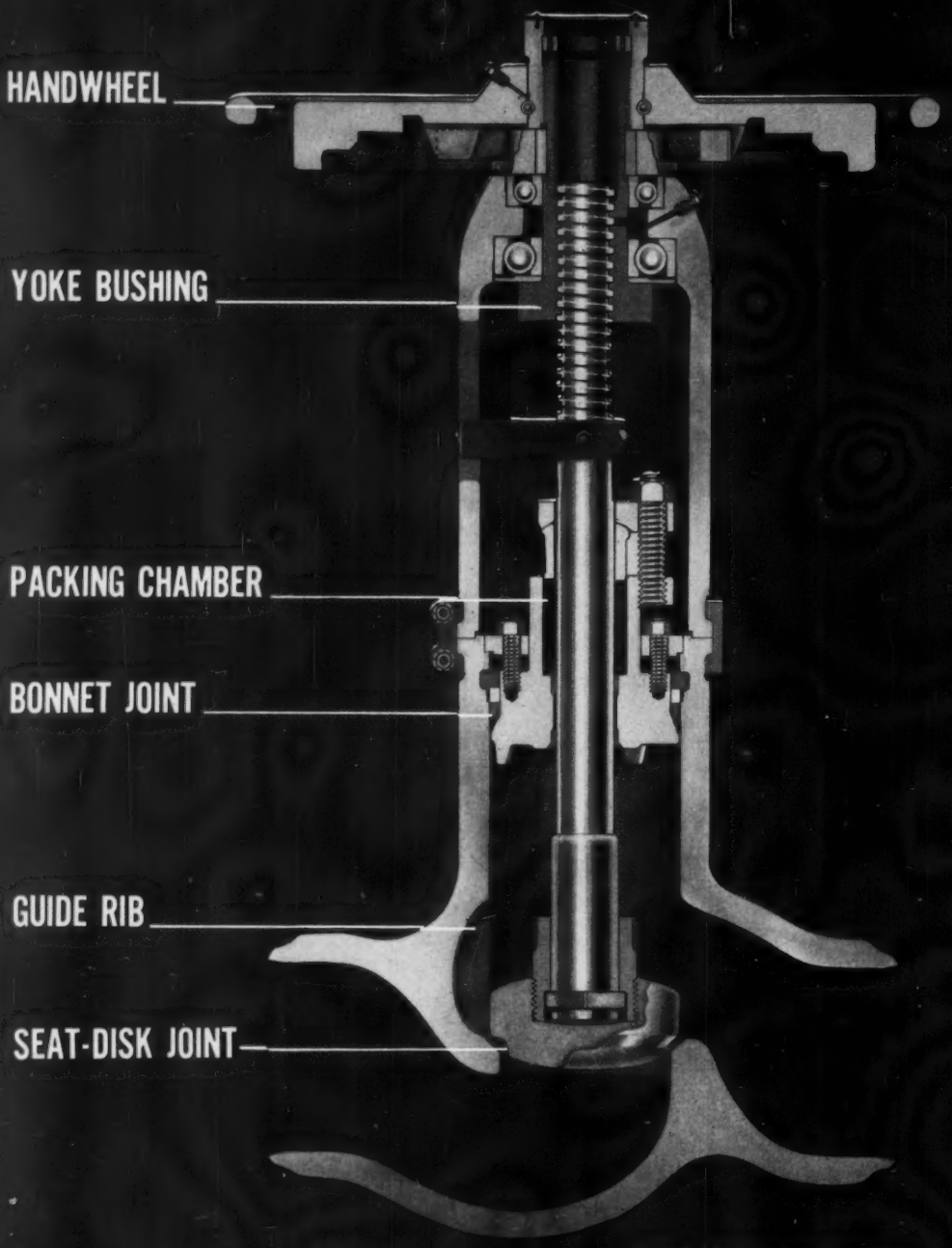
Metal-On also provides top fuel savings and accurate temperature control, because its insulating element is Johns-Manville Thermobestos®, finest of all the calcium silicate insulations for temperatures to 1200F. The conductivity of Thermobestos is lowest of all insulations generally used in power and process industries.

To help you compare Metal-On with the insulation you're now using—let us send you the new technical data brochure, IN-217A. Write for it today. Address Johns-Manville, Box 14, New York 16, N.Y.

JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS

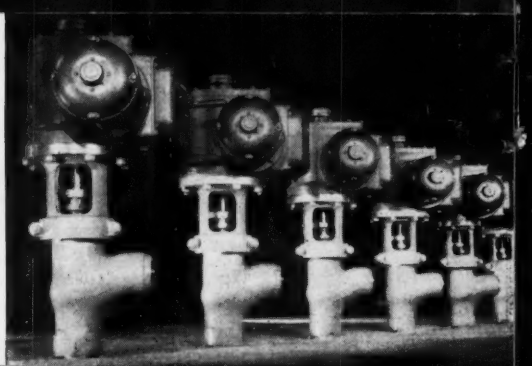
For more facts circle 788 on Reader Service card, p 227



EDWARD CAST STEEL
GLOBE VALVE FIG. 4016Y

IMPACTOGEAR® OPERATED VALVE

MOTOR OPERATED VALVES



What's New from Edward Valves

New Products . . . Solutions to Problems . . . Information on Steel Valves from Edward, Long-Time Pioneer in the Field!

HOW TO SELECT CAST STEEL VALVES

Valves for today's high-pressure processes require economy, dependability and safety in operation. The material on these pages is designed to help acquaint you with a few basic principles and features you should consider when selecting cast steel valves 2½ inches and larger.

VALVE FEATURES FOR LONGER LIFE, EASIER OPERATION

Valve Handwheel should be large enough to operate valve easily. On smaller valve sizes, a knobbed handwheel design permits tighter grip. But for larger, high-pressure valves, impact-type handwheels will increase closing force, insure tighter closure (see large illustration opposite page). Quick closing can be obtained with impact-type handwheels geared for closing with the aid of portable air or electric wrenches (bottom-left, opposite page). Or, where central or automatic control is desired, consider fixed motor operation (bottom-right, opposite page).

Yoke Bushing on larger valves in higher pressure classes should be equipped with double ball-bearing construction for reduced operating torque and effective transmission of closing load (large illustration on opposite page shows this design). Material is important, too. On smaller valves, bushings of bronze will help prevent stem seizing or galling. Look for ample thread engagement between bushing and yoke and between bushing and stem.

Packing Chamber should be large enough to insure long packing life. Valve packing must allow the stem to move within the bonnet but must not allow any fluid leaks between them. Well made packing, formed specifically for the packing chamber and correctly compounded for your pressure-temperature service conditions, has much to do with satisfactory valve performance. Valves with a positive backseat for re-packing while under pressure offer additional operating advantages.

Bonnet Joint of bolted construction (see Fig. 618 this page) is easiest to work with on medium or small size valves. But for lasting bonnet joint tightness, in high-temperature services (and for reduced size and weight), pressure-seal bonnet joint design is best—no flanges or bolting to periodically restress (see large illustration opposite page). Not all pressure-seal designs are alike, however. Avoid gaskets with small sealing surfaces and sharp edges that can be easily damaged and large threaded gasket loading mechanisms that are hard to disassemble and give unknown gasket compression.

Disk Guiding that properly centers the disk into the seat for positive shut-off regardless of position is important. Valve bodies with integrally cast guide ribs supporting disk throughout travel are best. Avoid designs which attempt to guide by installing spider in seat opening.

Seat-Disk Joint—An integral hard-faced seat is generally regarded as superior to screwed seat construction because it eliminates body-seat leakage and retains hardness under temperature. A hard-faced disk or disk of special alloy is desirable in high temperature services; but 13 per cent chromium stainless steel is an excellent all purpose material below 750° F.

Body Design with streamlined flow passage areas (opposite page) reduces wear-producing turbulence, decreases pressure drop and delivers maximum flow. Valves with streamlined body contours will often permit the use of smaller pipe and valve sizes. Angle valves (see Fig. 7517Y, upper right) have even less pressure drop.

For more detailed information, contact your Edward Representative, or write Edward Valves, Inc., 1230 West 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 360 Notre Dame Street, W., Montreal 1, Quebec.

Edward Valves builds a complete line of cast steel stop, check, non-return, stop-check and gate valves for pressures to 10,000 lbs. available with flanged or welding ends. Below are illustrated a few of the major valve designs from this complete line.

Fig. 7517Y
Angle stop valve, 1500 lb at 850 F. (3600 lb WOG), with integral Stellite seat, Stellited disk, pressure-seal bonnet, welding ends. 2½" to 14".

Fig. 618
Globe stop valve, 600 lb at 850 F. (1440 lb WOG), bolted bonnet, flanged ends, integral Stellite seat, Stellited disk. Sizes 2½" to 6".

Fig. 607Y
Angle non-return valve, 600 lb at 850 F. (1400 lb WOG), with pressure-seal bonnet, integral Stellite seat, Stellited disk-piston, welding ends, sizes 8" to 14".

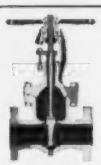


Fig. 611—Gate valve, 600 lb at 850 F. (1440 lb WOG), with hard-surfaced seats and wedge, ball bearing yoke, flanged ends. Sizes 2½" to 12".

Fig. 4094Y—Horizontal check valve, 900 lb at 850 F. (2160 lb WOG), with integral Stellite seat, Stellited disk-piston, pressure-seal cover, welding ends. Sizes 2½" to 14".

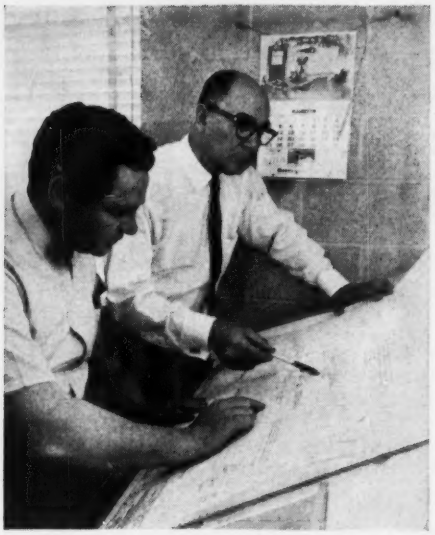
Fig. 7514—Flite-Flow globe stop valve, 1500 lb at 850 F. (3600 lb WOG) or 2500 lb at 850 F. (6000 lb WOG), with extremely low pressure drop and other premium features. Sizes 10" to 18".

EDWARD STEEL VALVES
another fine product by
ROCKWELL

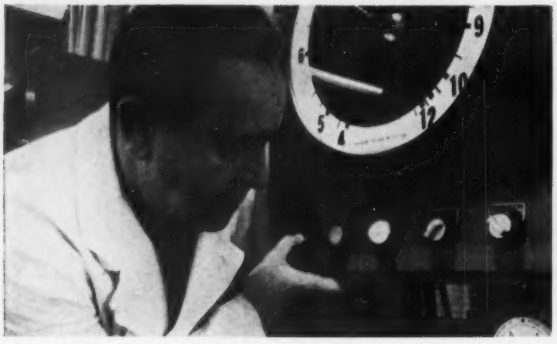
Catalog 14 contains full data on the complete Edward line of forged and cast steel valves from ¼" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs; for pressures up to 10,000 lbs: with pressure-seal, bolted, union or welded bonnets, with screwed, welding or flanged ends.

For more facts circle 789 on Reader Service card, p 227

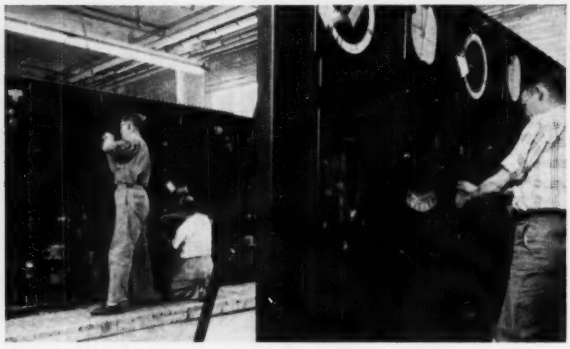
Honeywell gives you the most for your instrumentation dollar . . . BECAUSE YOUR COMPLETE MILL INSTRUMENTATION CAN BE INSTALLED BY THOSE WHO KNOW IT BEST



1. No "Will it work?" Worries. We custom design control systems for a single process or for your entire mill. This means instrumentation that is matched to your processes and will do the job you want it to do.



3. No Installation Headaches. We will contract to completely install instrumentation. Honeywell technicians will perform the prestart-up check out and deliver an operating control system to you. You get installation plus peak performance from your control system in the least possible time.



2. No Pre-Installation Problems. We carefully co-ordinate materials and labor; ship panels prewired and piped, ready to install. No need to recruit, relocate, or reassign personnel.

Honeywell offers you far more than just instruments. You can get all or any part of these time and money-savers. Add to these services our many years of engineering and application know-how. You'll see why Honeywell is your best buy in pulp and paper instrumentation, whether you deal directly with us or through your consultant or contractor.

Honeywell

First in Control

4. No Unscheduled Downtime. We can provide periodic maintenance by experienced service engineers—a big help in eliminating unscheduled downtime. Your instrument technicians are welcome at our Instrumentation Education Center in Philadelphia, where they receive free, expert training in the operation and maintenance of our products.

For more facts circle 790 on Reader Service card, p 227

Ingersoll-Rand Steam Condenser Serves

AXIAL-EXHAUST turbine

at MECO's Portland Station

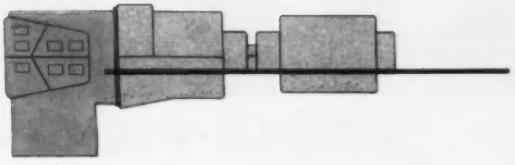
METROPOLITAN EDISON COMPANY'S new 165,000-kw Portland Station, designed and built by Gilbert Associates, Inc., features many advances in central station design — including the Ingersoll-Rand 80,000 sq. ft. surface condenser shown above.

To meet the unusual requirements of the axial-exhaust turbine and Monotube boiler, the condenser design incorporates the following features:

- Straight-through, horizontal steam path engineered for minimum friction and maximum pressure recovery . . . higher cycle efficiency.
- Reversible single-pass counter-flow cooling water circuit, convertible to two-pass operation.
- Hotwell storage of 16,000 gallons of deaerated condensate.
- Condenser is designed to receive steam by-passed from the Monotube boiler and features a built-in attemperating device.
- Welded tube ends prevent any possibility of feedwater contamination.

The Ingersoll-Rand condenser auxiliaries include circulating pumps, condensate pumps and air removal equipment consisting of two mechanical vacuum pumps with primary air-jet boosters. (Compressed air for soot-blowing and instrumentation is produced by Ingersoll-Rand compressors.)

For full details on this advanced condenser design, send for a copy of "The Condenser at Portland," Form 9306.

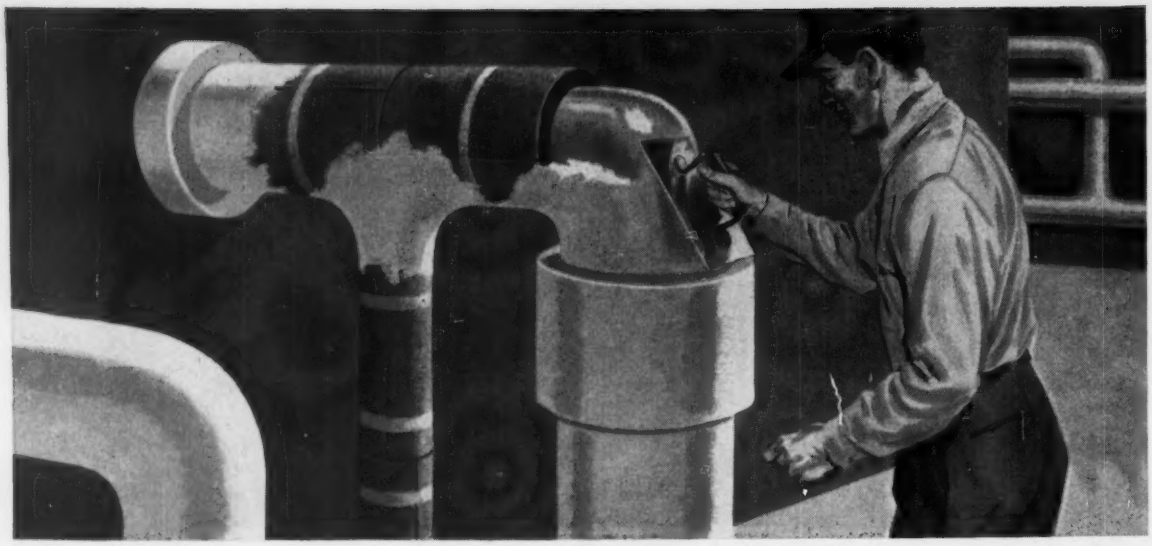


Simplified drawing of the Ingersoll-Rand 80,000 sq ft surface condenser connected to the axial exhaust turbine.

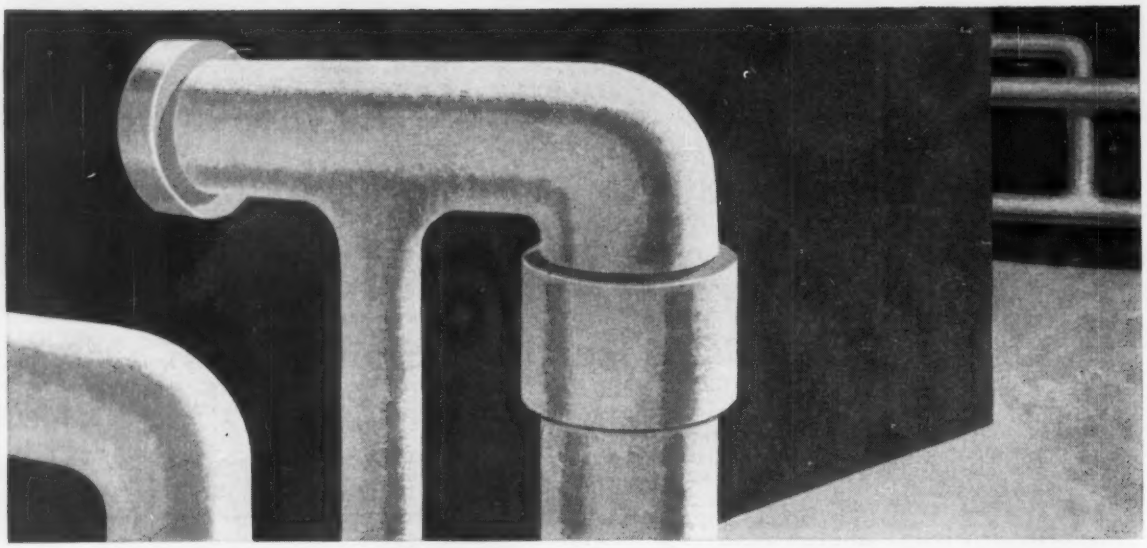
Ingersoll-Rand

4-952 ♥ 11 Broadway, New York 4, N. Y.

COMPRESSORS • GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS



ONE QUICK APPLICATION INSULATES, PROTECTS, FINISHES!



EAGLE-PICHER
ONE-COTE CEMENT

Eagle-Picher produces a complete line of industrial insulations for all temperatures from below Zero to over 2000 F.

EAGLE EP PICHER

Since 1843

The Eagle-Picher Company

Dept. P-10 Cincinnati 1, Ohio

(Member National Insulation Manufacturers Ass'n)

- Saves time, work, money! One quick application provides smooth, light reflectant surface on hot or cold equipment!
- Clean, easy to handle! Just trowel it on—even on irregular areas where application of other insulations is often impractical.
- Highly efficient! Effective insulation at temperatures up to 1000 F.
- For outdoor installations! Quick-setting, withstands rain and moisture two hours after application. Prevents rust!
- For indoor installations! Requires no wire mesh or finishing treatment!

For more facts circle 792 on Reader Service card, p 227

circle 793 on Reader Service card, p 227 ➤

Change hats
with your maintenance man . . .

You'll find out . . .

Vertical Lift Metal-clad is safer; you can see when it's disconnected

Peace of mind means a lot when your work involves contact with thousands of volts of electricity. Ask your maintenance man which make of metal-clad gives him peace of mind, and he'll tell you G-E Vertical Lift. He can see when the primary disconnects are parted—no need to guess whether or not the breaker is safely open. And, all live parts are automatically shielded as the breaker disconnects.

Before you buy your next switchgear line-up, consider your maintenance man and the see-able peace of mind only Vertical Lift Metal-clad can give him. General Electric Company, Schenectady 5, New York. 511-32

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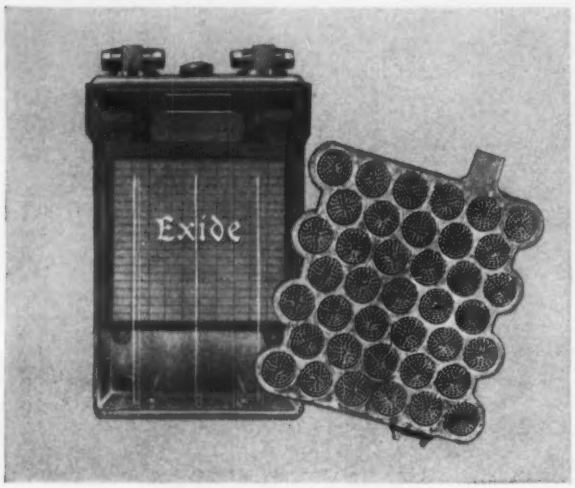
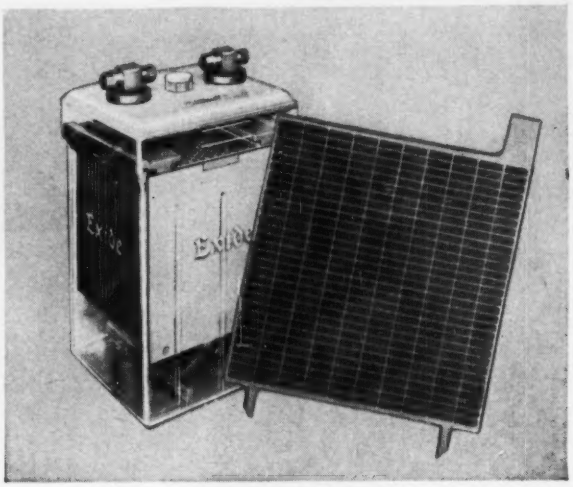
GENERAL ELECTRIC

Exide® INDUSTRIAL DIVISION The Electric Storage Battery Company, Philadelphia 20, Pa.

EXIDE STATIONARY BATTERIES

—broadest line in the field . . . unmatched for value and performance . . . models for all types of service





EXIDE-MANCHEX

Famous for long life the world over

Basic with the Exide-Manchex Battery is the unique positive plate. Heavily corrugated strips of high-purity lead are rolled into spiral buttons and forced under pressure into the heavy corrosion-resistant Silvium alloy grid. These buttons offer a total surface area to the electrolyte five times larger than the projected dimensions of the plate. Each button has a reserve supply of unformed lead for gradual conversion—longer battery life. Suspended plates and large bottom reservoir protect against sediment shorts. High-level electrolyte reduces frequency of need for watering.

EXIDE-TYTEX

Compact power proved in stationary service

Sizes for the widest variety of specific applications have been carefully developed over the years and constantly improved. Superior materials skillfully used provide maximum power for the greatest economy. Exide-Tytex Batteries are available in models with positive plate grids of Silvium, Exide's patented corrosion-resistant alloy, or of lead-calcium alloy. Silvium has been proved up to 100% more corrosion resistant than other commonly used grid alloys. Choose the type which best meets your particular requirements. Only Exide offers you so broad a choice of battery types and sizes.

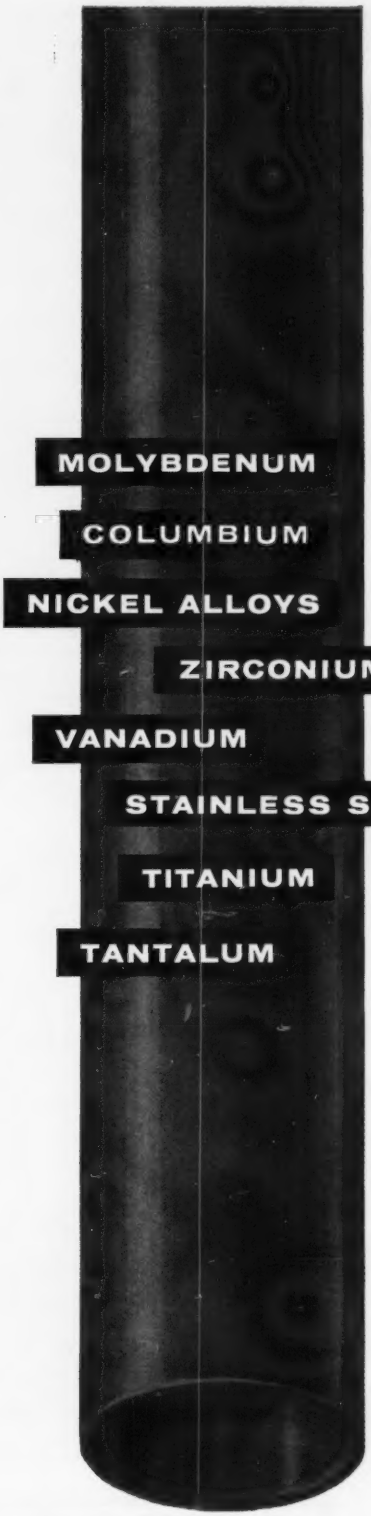
For additional information, contact the Exide office near you

Atlanta 10, Ga. ..... 1246 Allene Ave., S.W.
(Boston) Medford 55, Mass. ..... 315 Mystic Ave.
Chicago 9, Ill. ..... 5335 S. Western Blvd.
Cleveland 14, Ohio ..... 2225 Hamilton Ave.
Dallas 1, Tex. ..... 2133 McKinney Ave.
Detroit 4, Mich. ..... 8051 W. Chicago Blvd.
Kansas City 23, Mo. ..... 129 S. Belmont Blvd.
Los Angeles 15, Calif. ..... 1043 S. Grand Ave.
Minneapolis 3, Minn. ..... 1750 Hennepin Ave.
New Orleans 12, La. ..... 406 Civic Center Bldg.
New York 36, N.Y. ..... 25 W. 43rd St.
Philadelphia 4, Pa. ..... 101 N. 33rd St.
Pittsburgh 16, Pa. ..... 1608 Potomac Ave.
St. Louis 8, Mo. ..... 3928 Lindell Blvd.
San Francisco 24, Calif. ..... 6150 3rd St.
Seattle 1, Wash. ..... 500 Wall St.
Washington 16, D.C. ..... 4000 Albemarle St., N.W.

QUICK SELECTION CHART

amp-hr rating (8 hr)	Exide-Manchex	Exide-Tytex with Silvium	Exide-Tytex with Calcium
8-24	CME*		
10-30		COE*	
40-80	DMP		
50-100		PLX*, PWA†, DOP	PLX-A*, DCP
80-360	EMP		
120-400		EOP	ECP
180-660		EWA	EW
415-996	FMP		
469-1173		FOP	
840-1680		FWA	FW
4000-7000	(HE—this battery has conventional lead-antimony grids)		

*Assembled in 2- and 3-cell units with pilot balls †Assembled in 2- and 3-cell units without pilot balls



WOLVERINE TUBE WORKS IN METALS OF THE FUTURE

Today it is becoming increasingly important that your tubing source have experience in special metals as well as those in normal, daily use.

Wolverine Tube has this experience. Wolverine's continuous research and development program has, for many years, placed special emphasis on the production of tubing from metals of the future. In fact, Wolverine recently produced what is believed to be the longest piece of columbium tubing yet fabricated in the United States. The lineup of special metals in which Wolverine works is shown at the left.

To assure customers of competent sales guidance in this era of these metals of the future, Wolverine has also devoted special attention to the training of its Technical Sales Representatives. These men are qualified to discuss your metal requirements both in the field of heat transfer and tubular material selection.

For complete information ask for the services of a Wolverine Technical Sales Representative. Write, today, for a free copy of Wolverine's Nuclear Catalog.

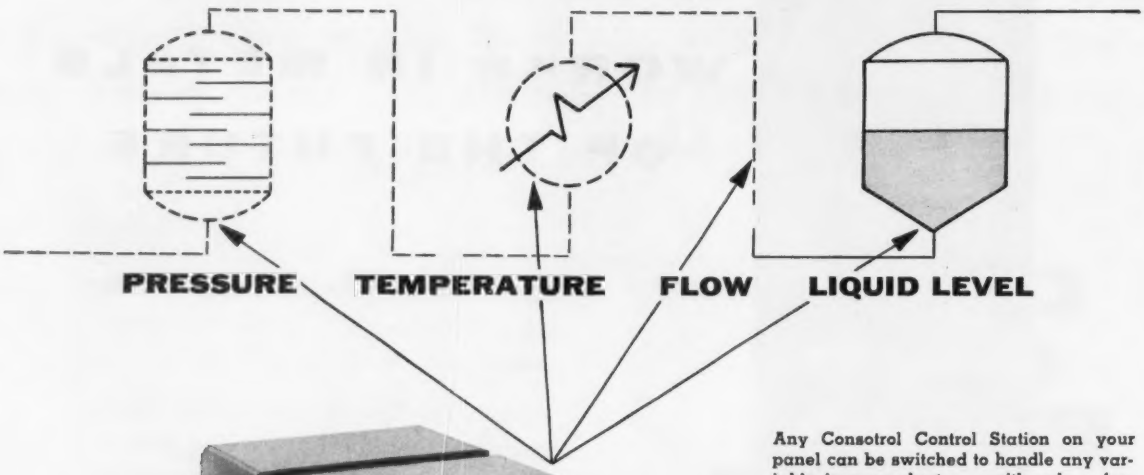
CALUMET & HECLA, INC.
CALUMET DIVISION
URANIUM DIVISION
GOODMAN LUMBER DIVISION
WOLVERINE TUBE DIVISION
In Canada:
CALUMET & HECLA OF CANADA LIMITED
WOLVERINE TUBE DIVISION
CANADA VULCANIZER & EQUIPMENT CO. LTD.
UNIFIN TUBE DIVISION

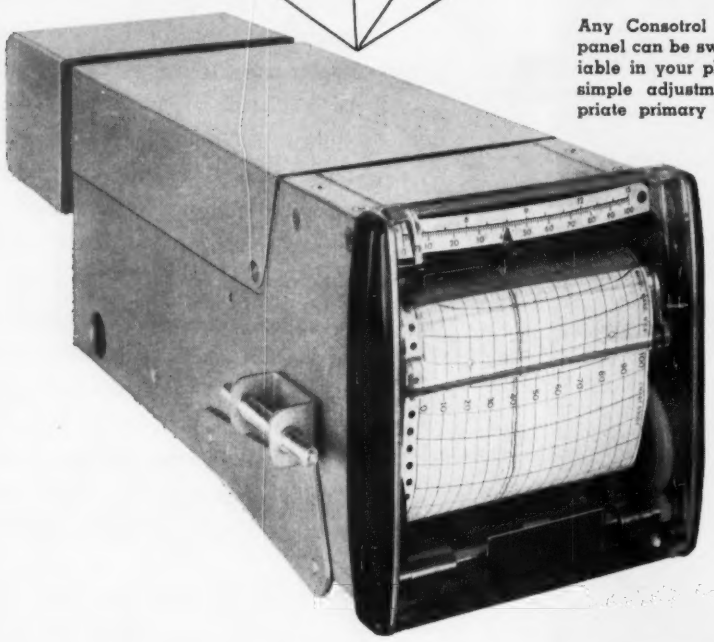
WOLVERINE TUBE
DIVISION OF
CALUMET & HECLA, INC.
17268 Southfield Road
Allen Park, Michigan
Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA
SALES OFFICES IN PRINCIPAL CITIES
EXPORT DEPT. 13 E. 40TH ST., NEW YORK 16, NEW YORK

For more facts circle 795 on Reader Service card, p 227

One recorder-controller for all your plant variables!





Any Consotrol Control Station on your panel can be switched to handle any variable in your plant . . . with only a few simple adjustments and use of appropriate primary element and transmitter.

That's right! The Foxboro Consotrol* Recorder-Controller is a "universal" instrument, equally adaptable to any plant measurement — whether flow, temperature, pressure, liquid level, or other.

All it takes is connection to the proper measurement transmitter having a 3-15 psi pneumatic signal . . . and making the appropriate controller settings. Changes such as adding derivative to reset or proportional control can be made on the job without special tools or realignments. You save needless duplication in capital investment . . . save time and trouble in making plant revamps . . . and get the unsurpassed performance of M/58 control on every application!

Whether you favor graphic, console, or conventional mounting, you can cut instrument overhead at every stage, step-up efficiency in every operation, with the Foxboro Consotrol Recorder-Controller. Write for Bulletin 13-18. **The Foxboro Company, 6810 Neponset Ave., Foxboro, Mass., U.S.A.**

*Reg.U.S.Pat.Off.

OTHER BASIC ECONOMIES

- **Simplified Ordering** – complex specification sheets are eliminated.
- **Reduced Stock Inventory** – only one type recorder-controller for all control jobs.
- **Reduced Maintenance** – fewest parts, rugged design, no stacked diaphragms, highest quality throughout.

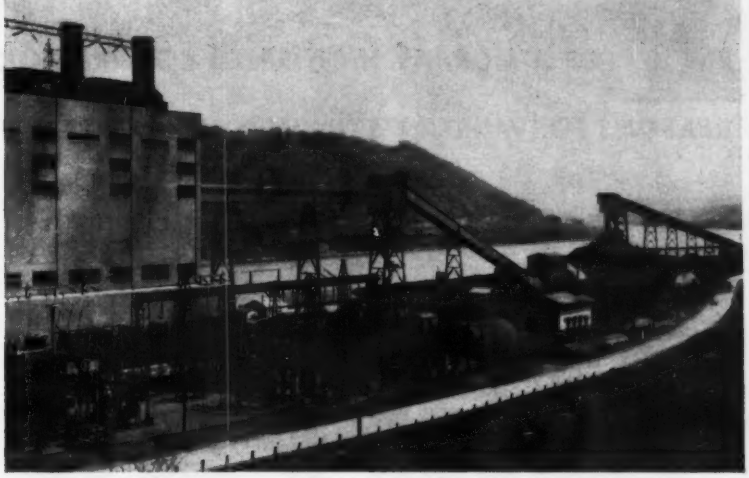
FOXBORO
REG. U.S. PAT. OFF.
CONSOTROL INSTRUMENTATION

For more facts circle 796 on Reader Service card, p 227

COMPLETE COAL HANDLING BY H&P ...belongs in your PLANT DESIGN PLANS

An H & P Contracting Engineer fits into your Plant Design plans. He is a specialist in his field and knows how to cooperate with Consulting Engineers.

Heyl & Patterson has more than 70 years of experience in the design, fabrication and erection of bulk material handling equipment. Let us assist in developing the most practical and efficient method of handling your coal out of barges or railroad cars, to and from stock-pile and into your bunkers.



Complete Coal Handling System designed and built by H & P, including Conveyors, Lowering Well and Bradford Breaker.

Other H & P products for Bulk Materials Handling:

Rotary Car Dumpers

•

Barge & Car Hauls

•

Barge & Boat Unloaders

•

Kinney Car Unloaders (for frozen coal)

•

Bradford Coal Breakers

•

Coal Sampling Systems

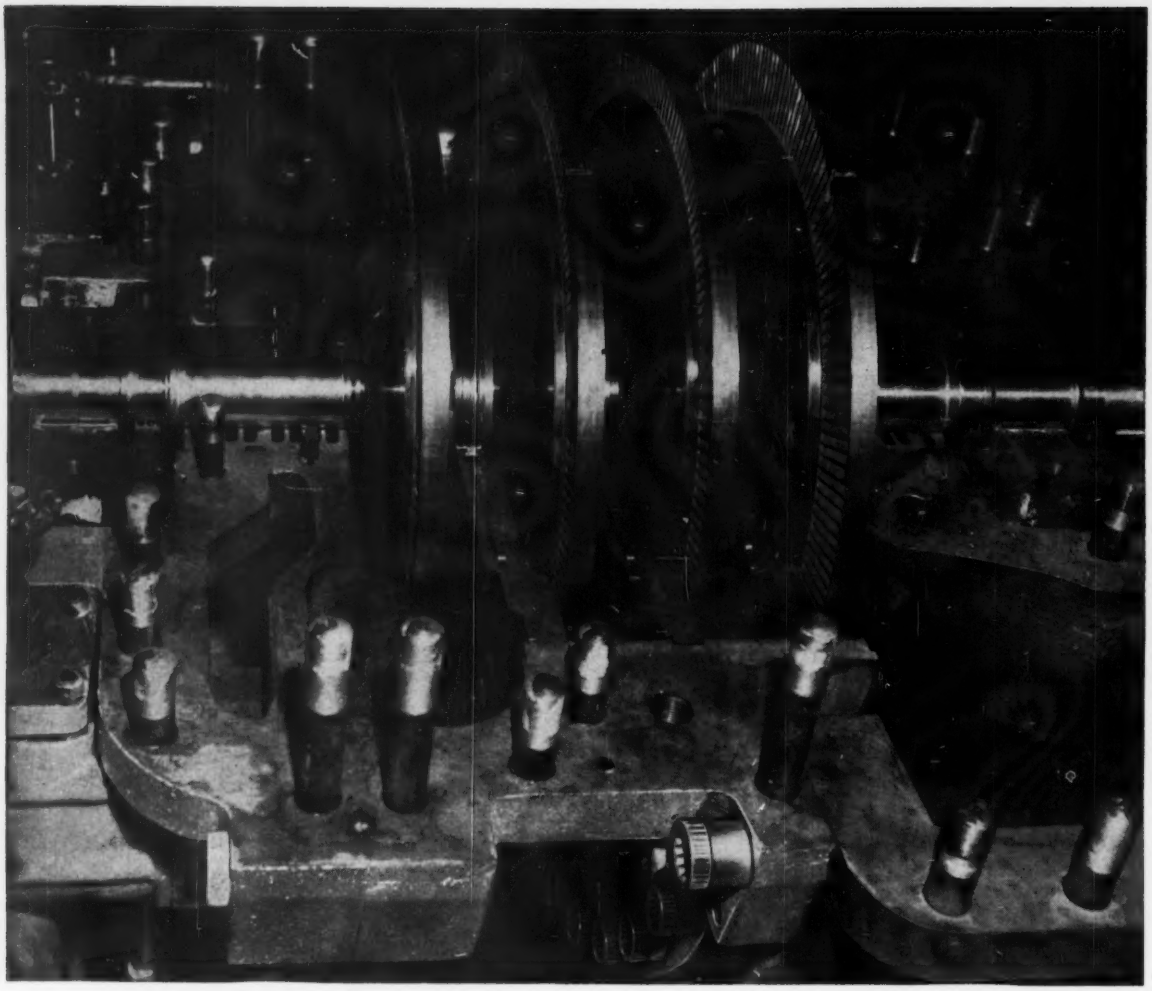
•

Specialized Conveying Systems

HEYL & PATTERSON, inc.

55 FORT PITT BLVD., PITTSBURGH 22, PA. • COurt 1-0750

For more facts circle 797 on Reader Service card, p 227



THE INSIDE STORY OF A MURRAY HIGH SPEED COMPRESSOR DRIVE TURBINE REVEALS THE REASONS FOR MURRAY'S UNIVERSAL ACCEPTANCE

A look at MURRAY'S rugged construction from the inside shows the husky shaft and heavy accurately formed discs with generous sized hubs designed to withstand the axial and radial stresses imposed by this type of service.

Large-dimension disc rims receive the specially contoured stainless steel blades with the Murray integral shroud. This insures smooth steam passages with maximum strength.

Short bearing spans insure smooth operation and eliminate the hazard of operating in critical speeds.

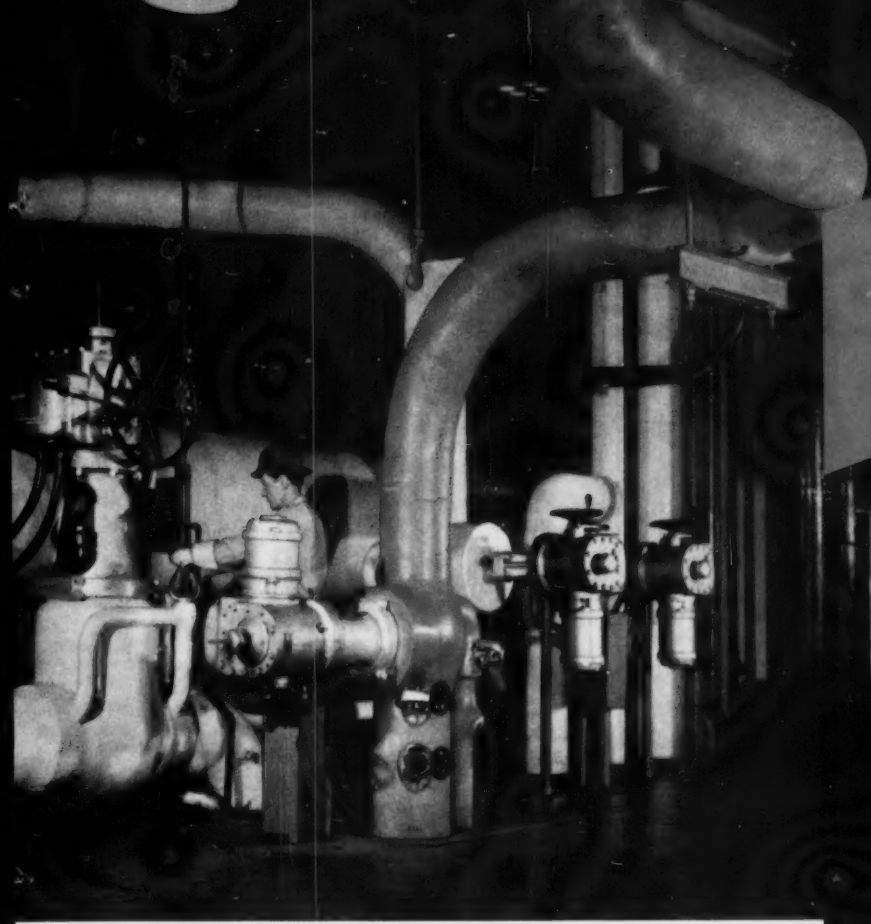
A look at the heavy flanges and husky bolting in the actual unretouched shop photo shown above bears out the extreme ruggedness that typifies every feature of Murray construction.

Our nearest representative will gladly help you solve your high speed compressor drive turbine requirements. Just write to Murray Iron Works Company, Burlington, Iowa, for his name.

Murray
TURBINES

MURRAY IRON WORKS COMPANY • BURLINGTON, IOWA
Builders of Steam Power Equipment for Nearly a Century

For more facts circle 798 on Reader Service card, p 227
circle 799 on Reader Service card, p 227



POWER: "Where steam is so hot it makes piping glow . . . velocity so great it would 'chew out' ordinary valves trying to hold it"

CRANE PRESSURE-SEAL BONNET VALVES

This is the place for

CRANE

PRESSURE-SEAL BONNET VALVES

LIP-SEAL BONNET VALVES

—the modern valves for high-pressure / high-temperature services

Pressure-Seal Bonnet Gates

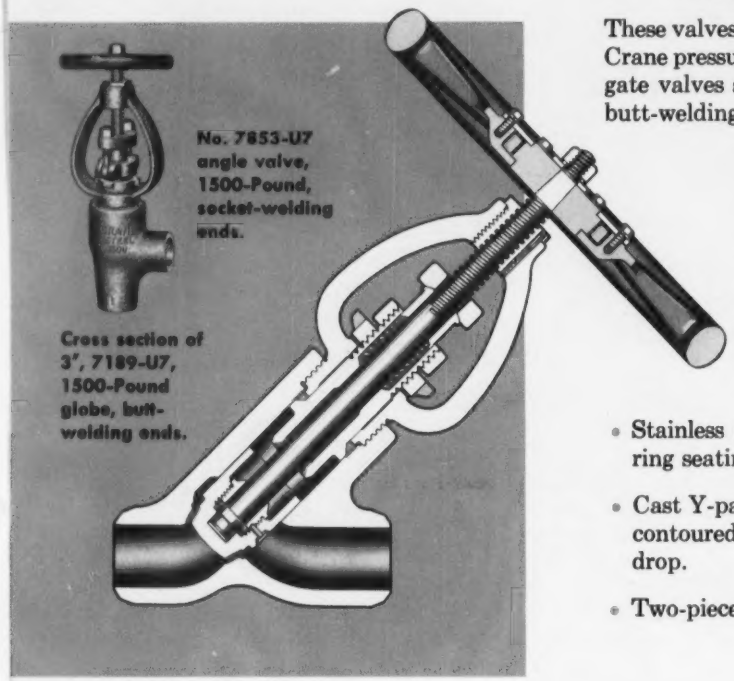
Lip-Seal Bonnet Globes and Angles

Since 1855 — Crane Co., General Offices: Chicago 5, Ill.
Branches and Wholesalers Serving All Areas

CRANE® Pressure-Seal Bonnet

Y-PATTERN GLOBE AND ANGLE VALVES

900-, 1500-, and 2500-Pound



No. 7853-U7 angle valve, 1500-Pound, socket-welding ends.

Cross section of 3", 7189-U7, 1500-Pound globe, butt-welding ends.

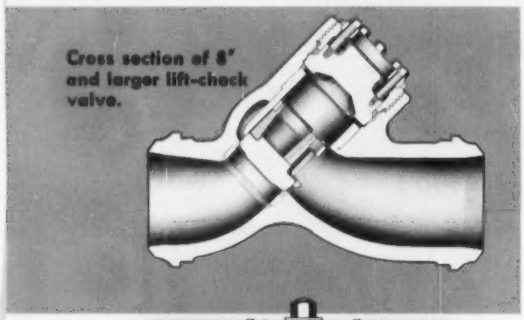
These valves give you all the advantages of the modern Crane pressure-seal bonnet principle as detailed for the gate valves shown opposite. Available in socket- and butt-welding ends.

Cost-cutting features

- Disc and seating surface *Stellite*-faced.
- Integral yoke and bonnet retaining ring, screwed into body in smaller sizes, clamp ring construction in larger sizes —maintain rigid alignment of body, stem and bonnet.
- Stainless steel inlay in body insures positive seal ring seating.
- Cast Y-pattern body, with smooth interior surfaces, contoured for minimum turbulence and pressure drop.
- Two-piece, ball-type packing gland can't bind stem.

NEW CHECK VALVES—HORIZONTAL GLOBE LIFT-CHECK DESIGN

900-, 1500-, and 2500-Pound

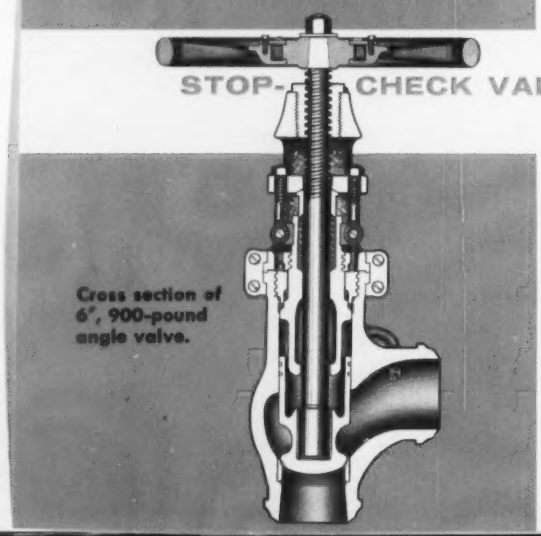


Cross section of 8" and larger lift-check valve.

Unique Crane design. Y-pattern body combines with Crane cage-type body liner construction to permit maximum flow with minimum pressure drop—without resorting to oversize seat opening. Piston-type disc and liner are the only internal parts. Crane design prevents entrapment of fluid above disc—insures proper disc operation.

STOP-CHECK VALVES—GLOBE AND ANGLE PATTERNS

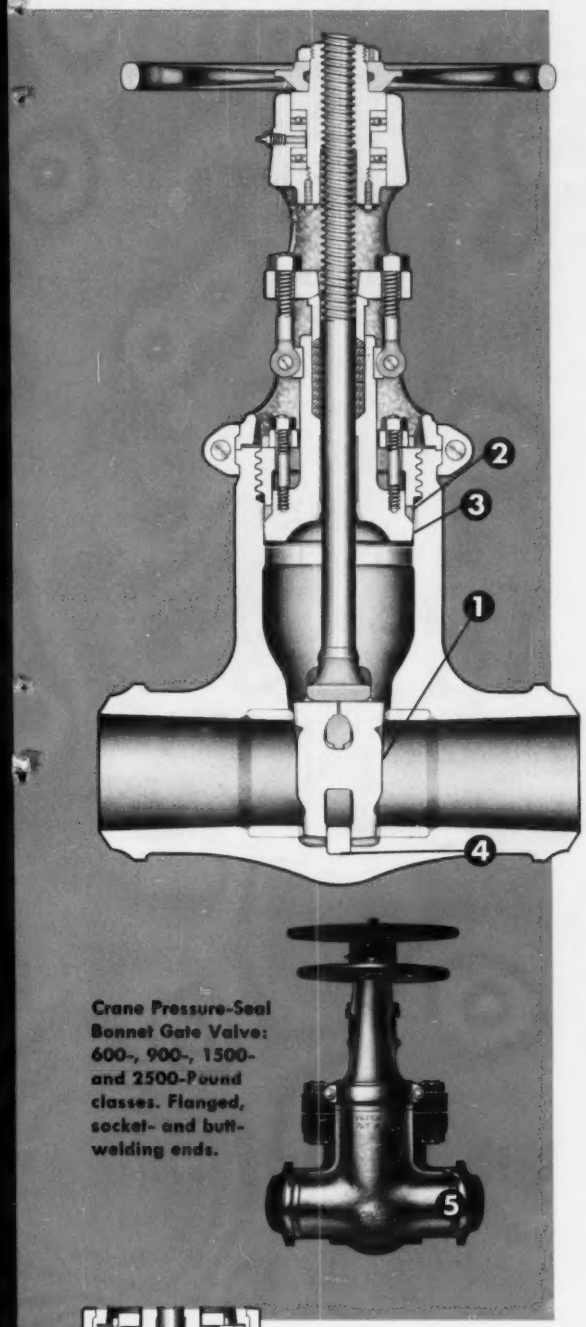
900- and 1500-Pound



Cross section of 6", 900-pound angle valve.

- Direct yoke-to-bonnet mounting—holds all parts in rigid alignment. Yoke swivels to any position for mounting valve operator.
- Stainless steel inlay in body insures positive seal ring seating.
- Two-piece, ball-type packing gland prevents stem binding.
- Easy to dismantle.
- No bonnet joint maintenance.
- *Stellite*-faced body seat ring is seal-welded in body—will not loosen in service.

Valves for all modern power control



Crane Pressure-Seal Bonnet Gate Valve: 600-, 900-, 1500- and 2500-Pound classes. Flanged, socket- and butt-welding ends.

GATE VALVES

600-, 900-, 1500- and 2500-Pound

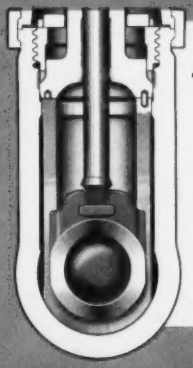
Here is the most modern valve designed for high-pressure/high-temperature service. Bonnet joint leakage is eliminated. Weight is reduced without sacrificing strength or safety. Its streamlined contour simplifies insulation. Special metals protect critical points of wear. No wonder it is the number one choice of power stations for trouble-free, minimum-maintenance service.

Note these features

1. Flexible wedge disc prevents sticking when valve is closed hot and opened cold—doesn't jam even when seated with excessive torque.
2. One-piece, silver-plated seal ring—secured by chrome-plated retaining ring screwed into the body—remains freeze-free for easy dismantling.
3. Wear-resistant stainless steel inlay in body insures tight sealing and maximum protection against corrosion.
4. Full-travel disc guiding to point of final closure—prevents wear and drag on seating surfaces.
5. Streamlined, weight-saving design saves up to 60% of weight of bolted bonnet valves—reduces suspension cost; simplifies insulation.

All Crane Pressure-Seal Bonnet Valves are ASA-rated.

Minimum metal thicknesses comply fully with the requirements of ASA B16.5-1957, as well as ASA Code for Pressure Piping and ASME Boiler and Pressure Vessel Code.

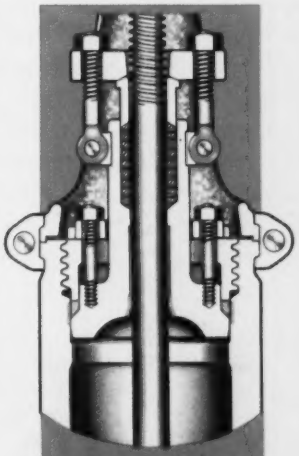


Tee-head disc-stem connection

Ample clearance between the head on the stem and the slot in the disc prevents side strains on the stem. Stem is only required to move the disc—not to serve as a guide.

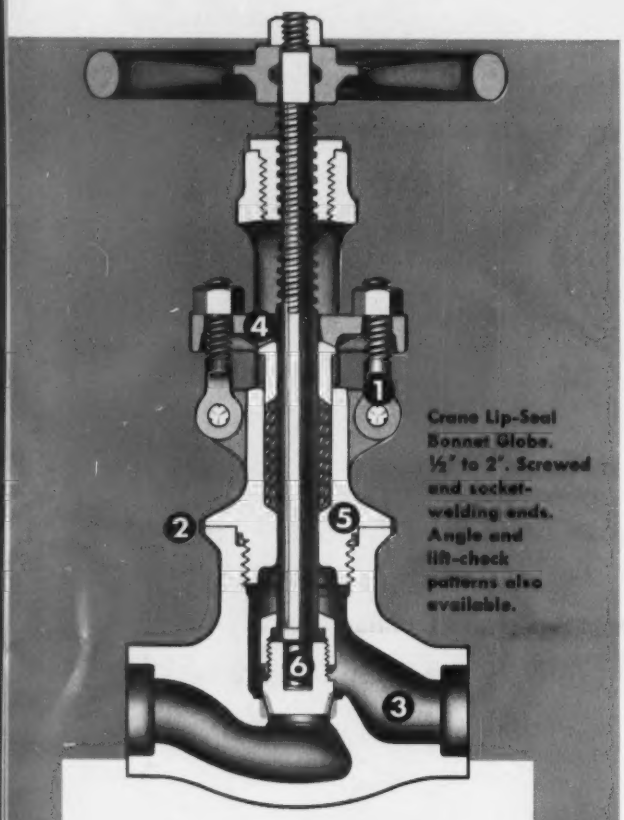
HOW PRESSURE SEAL IS MADE

Line pressure, acting upon the entire underside of the bonnet, forces it against the seal ring. The seal ring wedges between body and bonnet, forming a pressure-tight, metal-to-metal joint. The higher the pressure, the tighter the seal. Bonnet joint maintenance is eliminated. Except for minor modifications, the same pressure-seal principle is used on all types and sizes of Crane pressure-seal bonnet valves.



Pressure holds seal ring tight.

CRANE® Lip-Seal Bonnet Globe Valves



Crane Lip-Seal Bonnet Globe. ½" to 2". Screwed and socket-welding ends. Angle and lift-check patterns also available.

Crane quality features

1 Stainless steel eyebolts—prevent corrosion.

2 Welded bonnet joint lip-seal—eliminates bonnet joint maintenance, carries no mechanical load. Permits convenient grind-off, easy rewelding.

3 Compact design—no sacrifice of strength or size of port area.

4 Two-piece, ball-type packing gland—prevents binding on stem.

5 Body-centering lip—assures perfect body-bonnet alignment.

6 Improved disc-stem connection—assures positive closure and minimum vibration without hampering swivel action of disc.

3 PRESSURE CLASSES

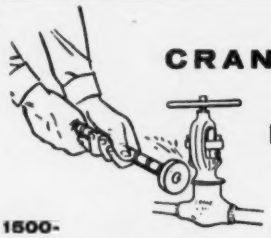
1500-Pound ASA – in carbon steel (WCB); 1570 psi, 1050 F (2500-Pound ASA) – in Crane No. 7 chrome-moly (WC6); 2520 psi, 1050 F – in Crane No. 7 chrome-moly (WC6).

Performance-proved in hundreds of power plants, these compact, tight-sealing valves are widely used on boiler feeds, blowdowns, drips and drains, bypasses, and similar applications.

Well-proportioned, cast valve bodies with specially shaped interiors provide smooth flow—minimize turbulence and disc vibration. Plug-type disc and seat are *Stellite*-faced to reduce wear. Stem and disc are fully guided for positive seating. Bonnet threads are chrome-plated to prevent galling and seizing. With weld removed, bonnet screws out . . . makes inside of valve easily accessible.

All Crane Lip-Seal Bonnet Valves are ASA-rated

Minimum metal thicknesses comply fully with the requirements of ASA B16.5-1957 as well as ASA Code for Pressure Piping and ASME Boiler and Pressure Vessel Code.



CRANE LIP-SEAL BONNET LIFT-CHECK VALVES

1500-Pound; 1570 psi, 1050 F

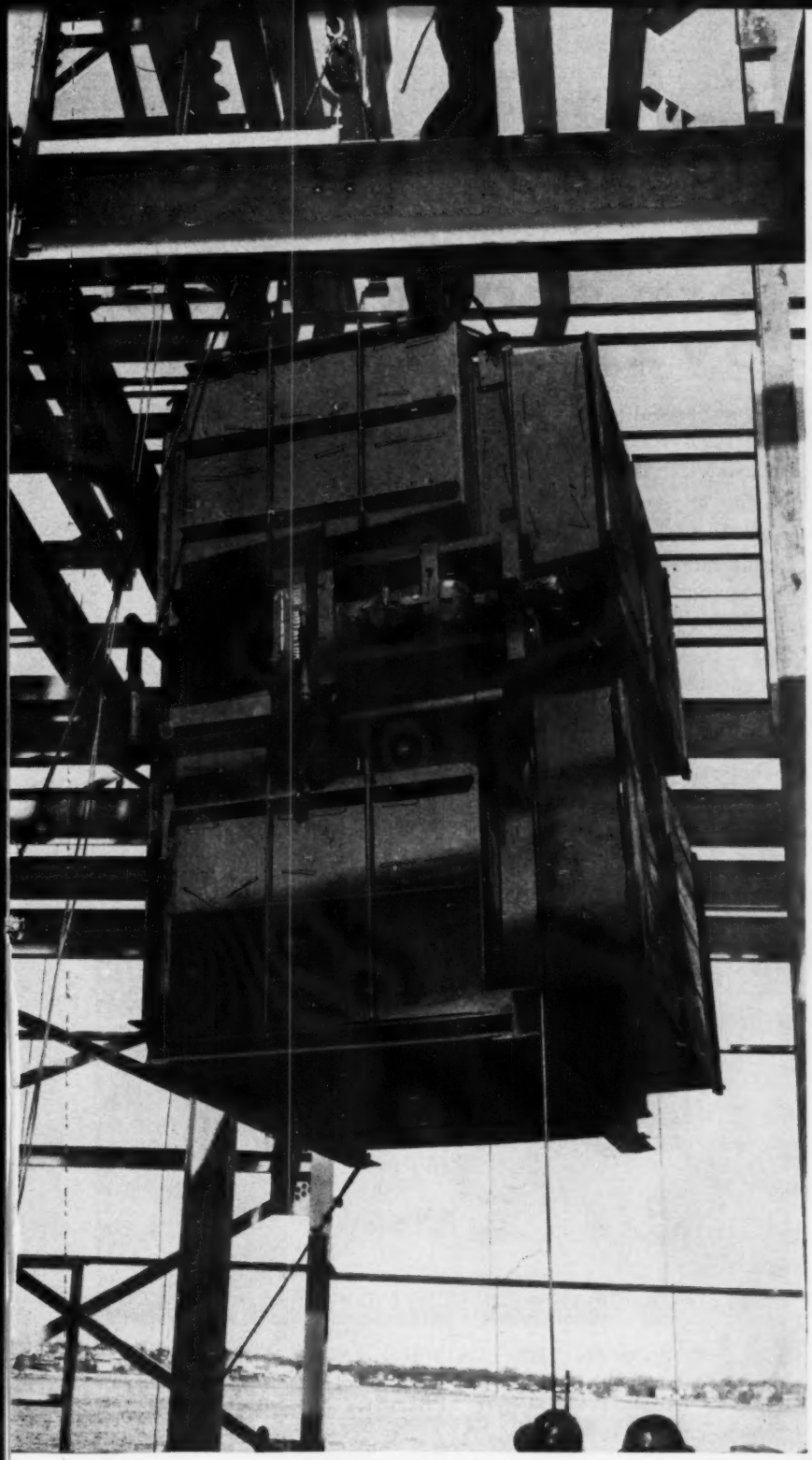
Available with screwed or socket-welding ends. ½" to 2". High disc lift assures free flow and minimum pressure drop. Offers all the advantages of Crane exclusive Lip-Seal weld design: elimination of bonnet joint maintenance . . . easy dismantling and reassembly . . . chrome-plated bonnet threads that prevent galling and seizing.

Write for Crane Lip-Seal Bonnet Valve Bulletin AD-2373.

CRANE® VALVES & FITTINGS

PIPE • PLUMBING • HEATING • AIR CONDITIONING

Since 1855 — Crane Co., General Offices: Chicago 5, Ill. — Branches and Wholesalers Serving All Areas



Complete and ready to run, Package Air Preheater is lowered through steelwork of new power station at Braintree, Mass. Installation at Braintree Electric Light Dept. uses largest available package preheater, with a diameter of approximately 12'. Fitted to a 130,000 lb per hr boiler, this Package Air Preheater will boost combustion air temperature by about 420°F with heat recovered from stack gas.

PACKAGE AIR PREHEATER

gives twofold economy at Braintree's new power station

PACKAGE DESIGN FACILITATES INSTALLATION; FUEL SAVINGS TO WRITE OFF COST IN 2 YEARS.

Braintree, Mass., has achieved an economic double-header with the Air Preheater in their new power station:

1. Initial saving: The Package Air Preheater, shown above, was delivered as a completely preassembled unit. All it needs is gas ducts and a power line and it's ready to work—installed at a fraction of the time and cost required for conventional units.

2. Long-term savings: Records prove that Braintree's Package Air Preheater can pay for itself—just on fuel savings alone—within two years.

Package design gives you these advantages on boilers as small as 25,000 pounds of steam per hour —or as large as 250,000 lbs per hr. And a Package Air Preheater is one of the surest ways to reduce fuel consumption: you cut your fuel bill 1% with every 45-50°F increase in preheated air temperature.

Get all the facts. Write today for your copy of the free 14-page booklet describing the multiple savings you get with a Package Air Preheater.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

For more facts circle 800 on Reader Service card, p 227

THE MODERN TREND IS TO COAL

WITH DETROIT STOKERS* FOR ECONOMY OVER THE YEARS!

Increasing numbers of forward looking engineers recognize that coal is the most economical fuel over the long term, and that it can be burned most efficiently with Detroit Stokers.

Stability of price and lower cost in most industrial areas have made coal the most favored fuel in new plants being built today.

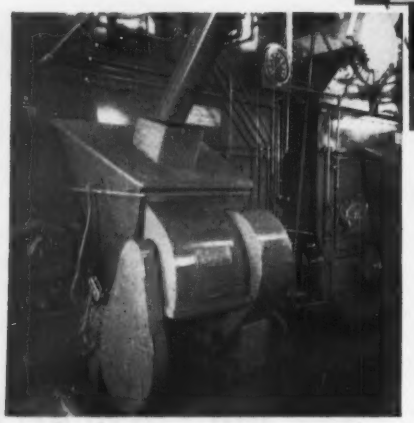
Detroit Stokers keep pace with this trend through continuous new developments and improvements that provide greater efficiency, easier operation and more economy.

Detroit Stokers are built for years of dependable service. Savings in fuel cost and maintenance continue to pile up long after the initial investment has been repaid.

This has been proved in hundreds of prominent Utility, Industrial and Institutional plants.

YOU can enjoy the benefits of modern, economical coal firing—Let us show you the Detroit Stokers best suited to your operating conditions.

Detroit RotoGrate Stoker—for boilers up to 400,000 pounds steam per hour capacity. A spreader stoker with forward moving grates which continuously discharge ash at the front.



Detroit LoStoker—capacity range 3,000 to 12,000 pounds steam per hour. An underfeed stoker of high efficiency—available with "start and stop" or "full floating control."

*BETWEEN THE LOSTOKER AND ROTOGRATE STOKER IS A COMPLETE LINE OF UNDERFEED AND OVERTHROW SPREADER STOKERS FOR EVERY NEED.

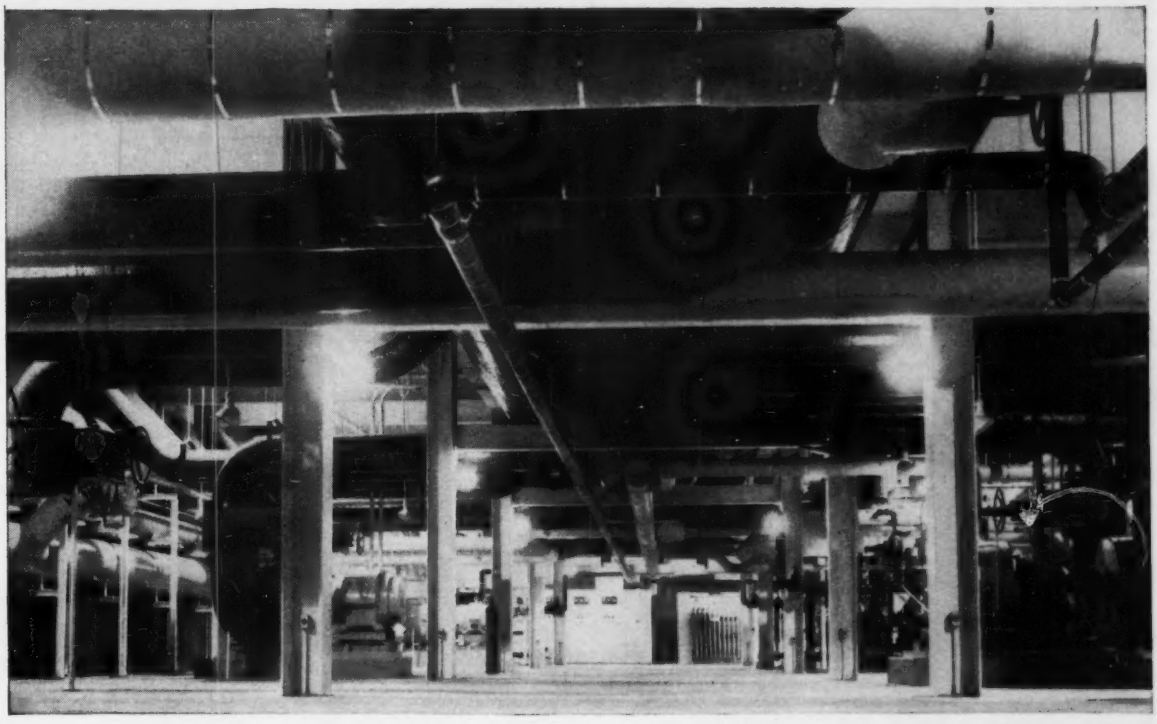
Detroit Stokers cost less: cost equals initial investment plus upkeep plus production losses due to equipment outage. The total is less with Detroit.

DETROIT STOKER COMPANY

Main Office and Works, Monroe, Michigan • District Offices or Representatives in Principal Cities

For more facts circle 801 on Reader Service card, p 227

The face of a commercial center



Architects and Engineers: Lane, Gamble and Associates; General Contractors: Robert E. McKee, Inc., and J. E. Morgan and Sons; Heating and Plumbing Contractors: Kiefler Plumbing and Heating Co., and Sam P. Wallace and Co.; Mechanical Engineers: Blum and Guerrero and William K. Hall and Co.

. . . and its heart

THIS IS EXCHANGE PARK IN DALLAS, TEXAS—a 125-million dollar commercial development of five multi-story office buildings, a regional shopping center, a hotel and a complete medical center.

Over 300 tons of USS National Seamless Pipe in sizes from 2⅜″ through 24″ were used in the heating and cooling system which serves the center from a utility plant. Steam at 250 psi working pressure is generated in the utility plant by five 50,000-pound boilers whose combined steam capacity is 250,000 pounds. This plant also has a refrigeration capacity of 12,000 tons, supplied by a system capable of handling close to 34,000 gallons of condenser water per minute, and is capable of meeting the needs of a city with 36,000 people.

Do you need quality pipe for power, heating and air-conditioning installations? You'll get it when you ask for "NATIONAL PIPE." If you'd like further information or immediate assistance with your pipe problems, write to National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

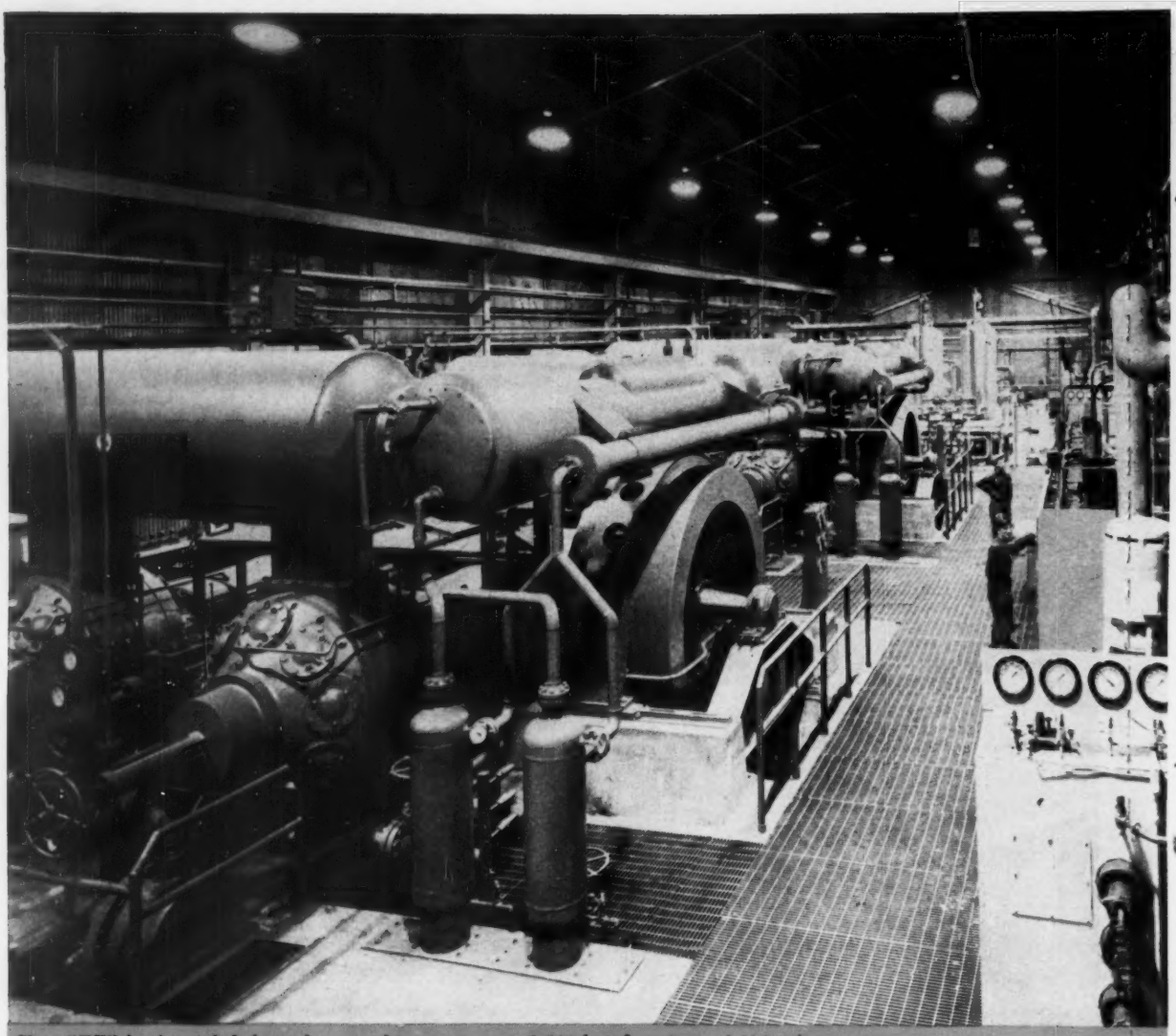
USS and National are registered trademarks

National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York

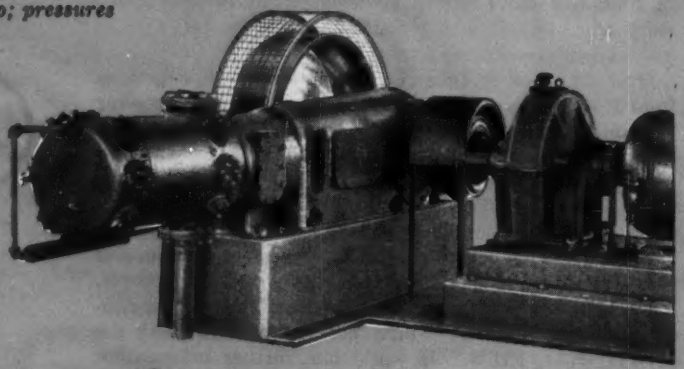
"The world's largest and most experienced manufacturer of tubular products"

For more facts circle 802 on Reader Service card, p 227



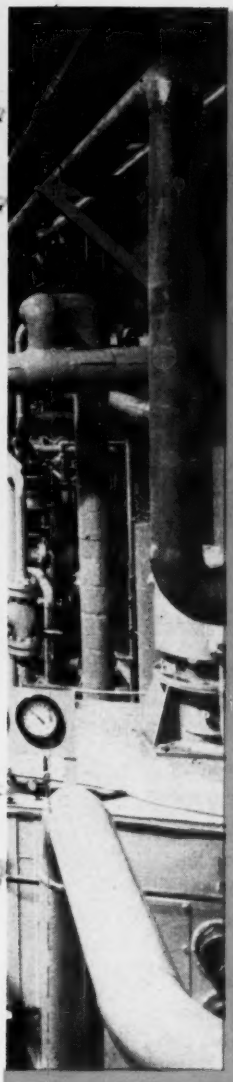
Class "FE" horizontal, balanced-opposed compressors; 3,500 hp; five-stage; 3,000 psig.

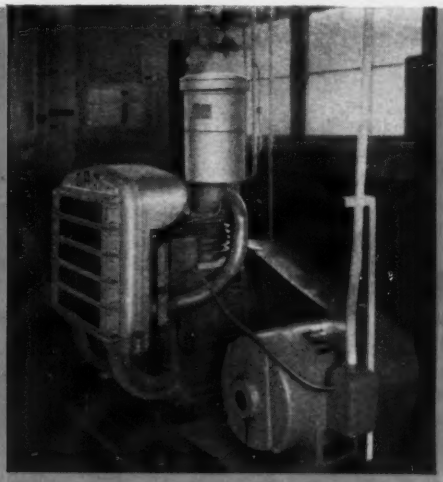
Type "T" single-stage, oil-less cylinder gear-driven hydrogen recycling compressor. Horizontal, straight line, double-acting types; single or multi-stage; lubricated or non-lubricated; 15 to 150 hp; pressures up to 5,000 psig.



Chicago Pneumatic 8 East 44th Street, New York 17, N. Y.

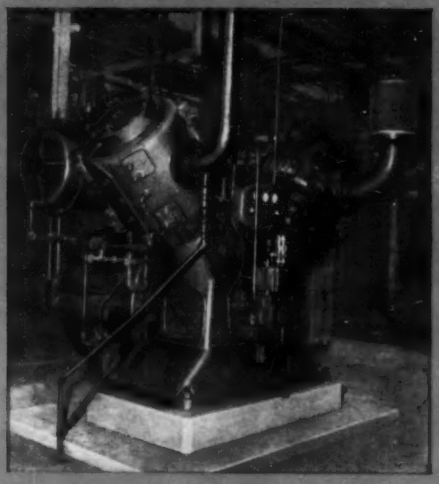
AIR AND GAS COMPRESSORS • VACUUM PUMPS • PNEUMATIC TOOLS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS



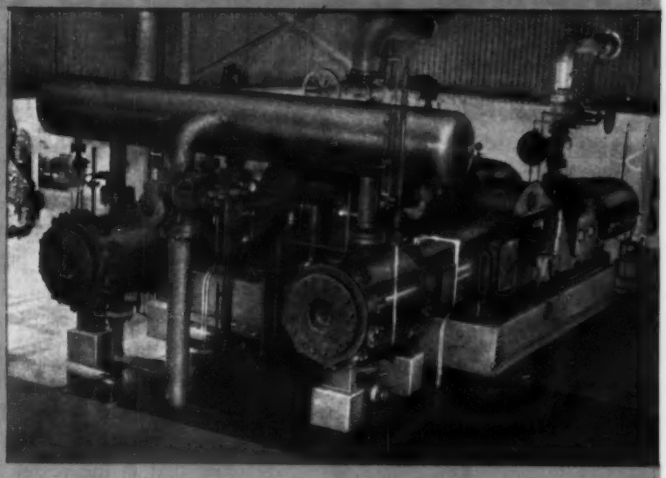


Type "P" air-cooled, motor driven compressor; 7½ to 125 hp.

Class "Y" package-type compressor; 75 to 300 hp; pressures up to 5,000 psig; lubricated or non-lubricated.



Class "H" four corner, steam-driven compressor; 150-1400 hp. One of two 30" stroke, 1,000 hp hydrogen recycling units.



from VACUUM to 15,000 PSIG

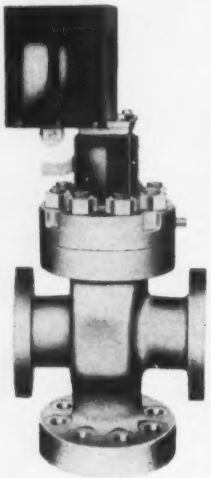
7½ to 5,000 HP

There's a CP COMPRESSOR for every process need

For more facts circle 803 on Reader Service card, p 227

PRESSURE LOADED SEATING

minimizes leakage and maintenance



Consolidated Electromatic Relief Valve. Sizes: 2½" to 14". Pressures to 3000 psi. Temperatures to 1120°F. Double Outlet.

Consolidated Electromatic® Relief Valves save steam, pure water, fuel, and "wear and tear" on your spring-loaded valves. Pressure loaded seating permits closer adjustment between operating pressure and set point than in spring-loaded valves. Many Electromatics are used to purge superheaters for faster startups and as superheater vent valves. They greatly reduce chances of superheater damage when firing up a cold steam generator or banked boiler.

Pressure loaded seating is created by channeling steam from the pressure vessel around the Electromatic's exhaust and into its main and pilot valve chambers. Steam pressure in both chambers always matches that in the vessel when the Electromatic is closed.

When pressure exceeds the Electromatic's set point, a signal from controller to panelboard control station results in solenoid thrust that opens the pilot valve, venting the steam faster than it can enter the pilot valve chamber through the clearance between the main valve disc and guide. With pressure in the chambers unbalanced, the main valve opens; steam exhausts until boiler pressure is reduced to the pre-determined setting of the controller. The pilot valve and the main valve close instantly at this point. Action is so fast, the closely adjusted Consolidated Electromatic normally relieves overpressure before the spring-loaded valve's set point is reached. For automatic or manual operation or to cut the valve out of service, a switch is provided on the control station. Send for Bulletin 720.

MAXWELL MANNING MM&M MOORE INC. TRADE MARK

CONSOLIDATED SAFETY VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

For more facts circle 804 on Reader Service card, p 227

circle 805 on Reader Service card, p 227 ➤

FLEXIBLE METALLIC

Style: 811 Ring, Spiral

Flexible; formed from folded and crimped metal ribbons; interstices filled with graphite and mineral oil lubricant; for use on oil, water and gasoline; temperatures to 450° F.

ALL ALUMINUM

Style: 861 Ring, Spiral

Soft, annealed aluminum foil, no fabric core; for use as end rings at temperatures to 1000° F.; for rods of not less than 500 Brinnell hardness.

BRAIDED COPPER

Styles: 199 (Ring)
299 (Spiral)
399 (Coil)

Soft annealed copper wire, tightly braided in square or plaited form; for use at high temperatures, on rods of engines, and plungers of hot oil pumps; requires slight lubrication.

ANCHOR 851-TT

Styles: 851-TT Die Formed Rings, Coils. Long fiber asbestos yarn, armored with low-frictional metal, lubricated. Features resiliency, flexibility; temperatures to 450° F.

ANCHOR METALLIC PACKINGS safeguard the life of moving parts

Among other important advantages, Anchor metallic packings combine high packing efficiency with *lowest possible friction to moving parts.* As a result, Anchor metallic packings last longer than other types. What an ideal way, then, to extend the life of rods, shafts or plungers that are running in true alignment free from wear or scoring.

Anchor metallic packings effectively seal against water, oil, air, steam and hot gases at temperatures up to 1000° F. and pressures to 1000 PSI. Many types are available in lead, copper and aluminum for use on iron, steel, Monel metal and hard bronze parts. Their use on soft metal parts usually requires lubrication.

The Anchor Packing Company—with more than 50 years experience in the mechanical packing industry—specializes in designing the packing for the application. If you have a packing problem, consult your local Anchor Representative. He will gladly help you. Or, contact the Anchor General office in Philadelphia. For information on the many Anchor products, write for our catalog.

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Found in Every Yellow Pages

THE ANCHOR PACKING COMPANY

GENERAL OFFICES PHILADELPHIA, PENNSYLVANIA
FACTORIES MANHEIM, PA. ELKHART, IND. MONTREAL, CAN.

● FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

How lasting quality is Heat Exchanger

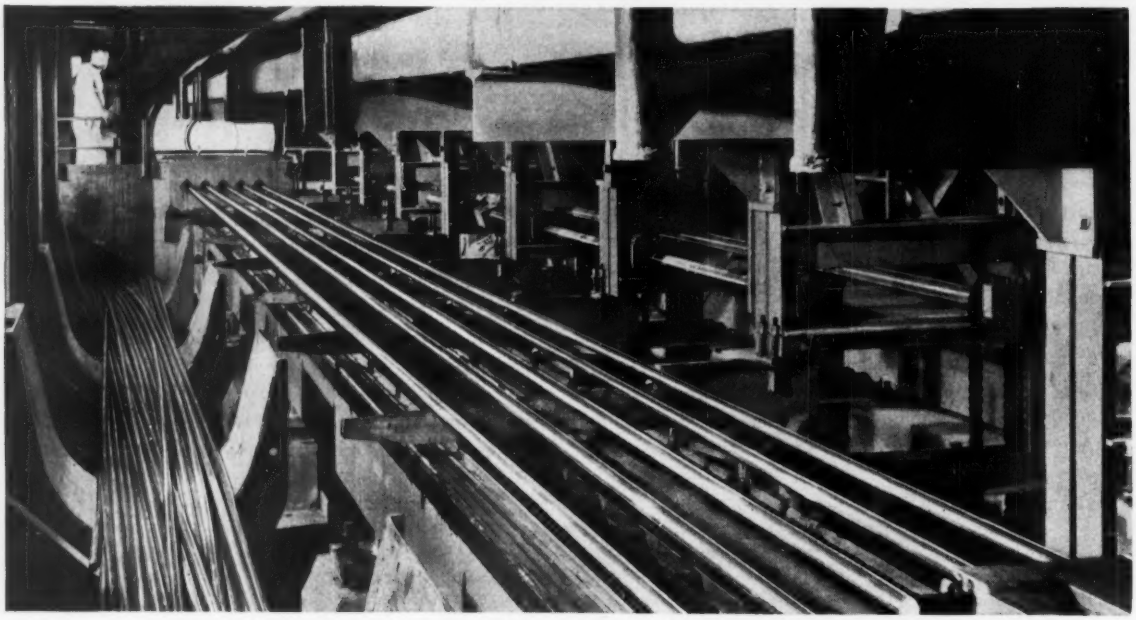
Drawing is a basic tube fabrication operation that transforms newly extruded tubes into standard and special size tubes for various applications. Phelps Dodge uses the cold-drawing process, a method in which precise control and master craftsmanship are combined to produce tubes that meet the most exacting specifications.

The cold-drawing method is used throughout, because it assures maximum tube quality through carefully coordinated operations on a drawbench where simple axial tension is applied.

After initial lubrication the tubes are brought to the drawbench. Each tube is slipped over a mandrel and hollow supporting rod, then drawn through a die and over the mandrel to form a tube of the desired diameter and wall thickness. Continuous lubrication is applied to each tube during this operation to control surface quality and minimize heat generated during the processing cycle.

Dual-gauge tubing is the result of a modified drawing operation which was developed by Phelps Dodge. In this operation, a heavier wall thickness is provided at one or more points of the tube length to compensate for thinning of the outer portions of return bends. In this manner, uniform thickness is retained where ordinary tubes thin out.

Throughout the entire tube fabricating operation—from raw materials to finished product—quality is the keynote. That's why Phelps Dodge tubes are preferred by those who demand the finest . . . the manufacturers and users of heat exchangers and condensers.

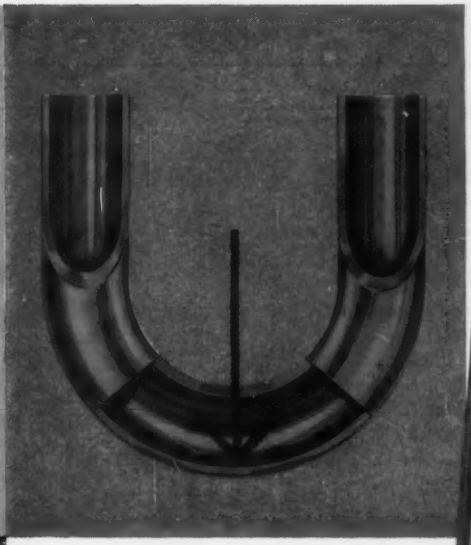


In automated drawing operation at new Phelps Dodge mill, tubes are pulled through reducing dies into smaller diameters and longer lengths.

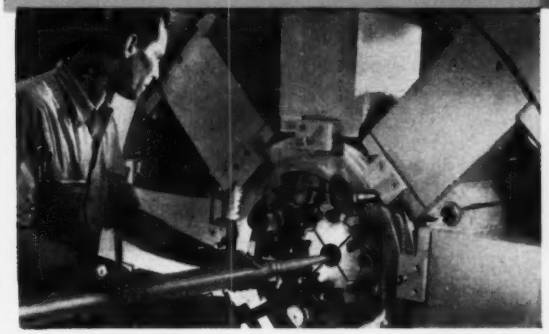
built into Phelps Dodge and Condenser Tubes...

3 DRAWING

(THIRD OF A FIVE-PART SERIES)



Cutaway of Dual-gauge tube; note how extra metal provides additional safety factor by retaining uniform wall thickness at return bend.



Pointing one end of an extended copper shell, a preliminary step in the drawing process.

PHELPS DODGE COPPER PRODUCTS CORPORATION

First for Lasting Quality—from Mine to Market!

SALES OFFICES: Atlanta, Birmingham, Ala., Cambridge, Mass., Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Dayton, Denver, Detroit, Fort Wayne, Greensboro, N. C., Houston, Indianapolis, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.

For more facts circle 806 on Reader Service card, p 227

What's the latest in

C-E BOILERS* FOR HIGHEST STEAM PRESSURES

COMPANY	STATION	No. of Units	Throttle Pressure	Steam Temperature	Capacity—kw Total
		FOR SUPERCRITICAL PRESSURES			
Philadelphia Electric Co.	Eddystone	1	5000	1200/1050/1050	325,000
Philadelphia Electric Co.	Eddystone	1	3500	1050/1050/1050	325,000
Cleveland Electric Illuminating Co.	Avon	1	3500	1100/1050	215,000
		FOR SUBCRITICAL PRESSURES — ABOVE 2400-LB			
Metropolitan Edison Co.	Portland	1	2520	1050/1050	165,000
Metropolitan Edison Co.	Portland	1	2520	1050/1000	225,000
New England Power Co.	Brayton	1	2520	1000/1000	250,000
Virginia Electric & Power Co.	Chesterfield	1	2520	1000/1000	167,000
Virginia Electric & Power Co.	Possum Point	1	2520	1000/1000	225,000
Dayton Power & Light Co.	Tait	2	2490	1050/1000	260,000
		FOR SUBCRITICAL PRESSURE — 2400-LB			
Central Hudson Gas & Electric Co.	Danskammer	1	2400	1050/1000	125,000
Cincinnati Gas & Electric Co.	Beckjord	1	2400	1050/1000	156,250
Cincinnati Gas & Electric Co.	Miami Fort	1	2400	1050/1000	156,250
Cleveland Electric Illuminating Co.	Ashtabula	1	2400	1050/1050	225,000
Cleveland Electric Illuminating Co.	Eastlake	1	2400	1050/1050	187,500
Cleveland Electric Illuminating Co.	Lakeshore	1	2400	1010/1010	225,000
Consumers Power Co.	Karn	1	2400	1050/1050	250,000
Consumers Power Co.	Port Sheldon	1	2400	1050/1000	250,000
Detroit Edison Co.	St. Clair	1	2400	1050/1000	325,000
Duke Power Co.	Allen	2	2400	1050/1000	330,000
Duke Power Co.	Allen	3	2400	1050/1000	825,000
Duke Power Co.	Lee	1	2400	1050/1000	165,000
Niagara Mohawk Power Co.	Dunkirk	2	2400	1050/1000	400,000
Niagara Mohawk Power Co.	Huntley	2	2400	1050/1000	400,000
Pennsylvania Electric Co.	Shawville	2	2400	1050/1000	330,000
Pennsylvania Power & Light Co.	Brunner Island	1	2400	1000/1000	300,000
Philadelphia Electric Co.	Schuylkill	1	2400	1050/1000	175,000
Potomac Electric Co.	Dickerson	2	2400	1050/1000	350,000
South Carolina Electric & Gas Co.	McMeekin	3	2400	1050/1000	375,000
Tennessee Valley Authority	Widows Creek	1	2400	1050/1000	500,000

* The above list covers American utilities only. Abroad, too, the C-E Controlled Circulation Boiler has achieved a predominant position for 2400-lb applications, evidenced by orders placed with C-E or its licensees for 23 units with an aggregate capacity of 5,030,750 kw.

COMBUSTION

Combustion Engineering Building

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;

Steam Pressures?

Although one unit for supercritical pressure is presently in service and others soon will be, today's pressure plateau is in the 2400-2520 psi range.

It appears inevitable that many new units will be purchased for this pressure cycle, since it offers a heat rate gain of about 185 Btu over the 1800-psi pressure class. With ever-increasing fuel prices, there is ample incentive to move up to these higher pressures.

In the entire area of high pressures, temperatures and capacities, Combustion is playing a leading role. As indicated by the list on the opposite page, 39 C-E units have been purchased for use in the 2400-lb. pressure range and above—33 of the Controlled Circulation design. The turbine-generator capacity for the 39 units listed totals over 8-million kilowatts. Already, 16 of these units are in service supplying steam to produce more than 2½-million kw. One has been in service over 3 years.

Later this year, a C-E Sulzer Monotube unit, designed for the highest steam pressure and temperature to date (5000 psi at 1200 F), is scheduled to go into service at the Eddystone Station of Philadelphia Electric Company. Two more supercritical pressure units, for 3500 psi, are now under construction. Similar units for subcritical pressure are already in service for Metropolitan Edison Co. and Dayton Power & Light Co.

Along with higher pressure, the trend is toward higher unit capacities. In another year, the average size of high pressure units purchased should be up to 250 megawatts as compared to an average of 200 mw, for the units listed on the opposite page.

ENGINEERING

200 Madison Avenue, New York 16, N. Y.

C-E

C-218A

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

For more facts circle 807 on Reader Service card, p 227

be sure to consider...

TOTAL VALUE

General Electric Master Unit Substations are your best "total value" buy—most advanced transformer, switchgear designs . . . completely integrated for modern, economical power distribution

For a "total value" product appraisal, consider these over-all advantages of factory-built unit substations, then factor in the product superiority of G-E transformer and switchgear components.

Centralized responsibility with General Electric means you get a modern, integrated, expertly engineered product like the unit substation shown below which supplies power for United States Gypsum Company's new plant at Galena Park, Texas. Your engineering staff is freed for other projects.

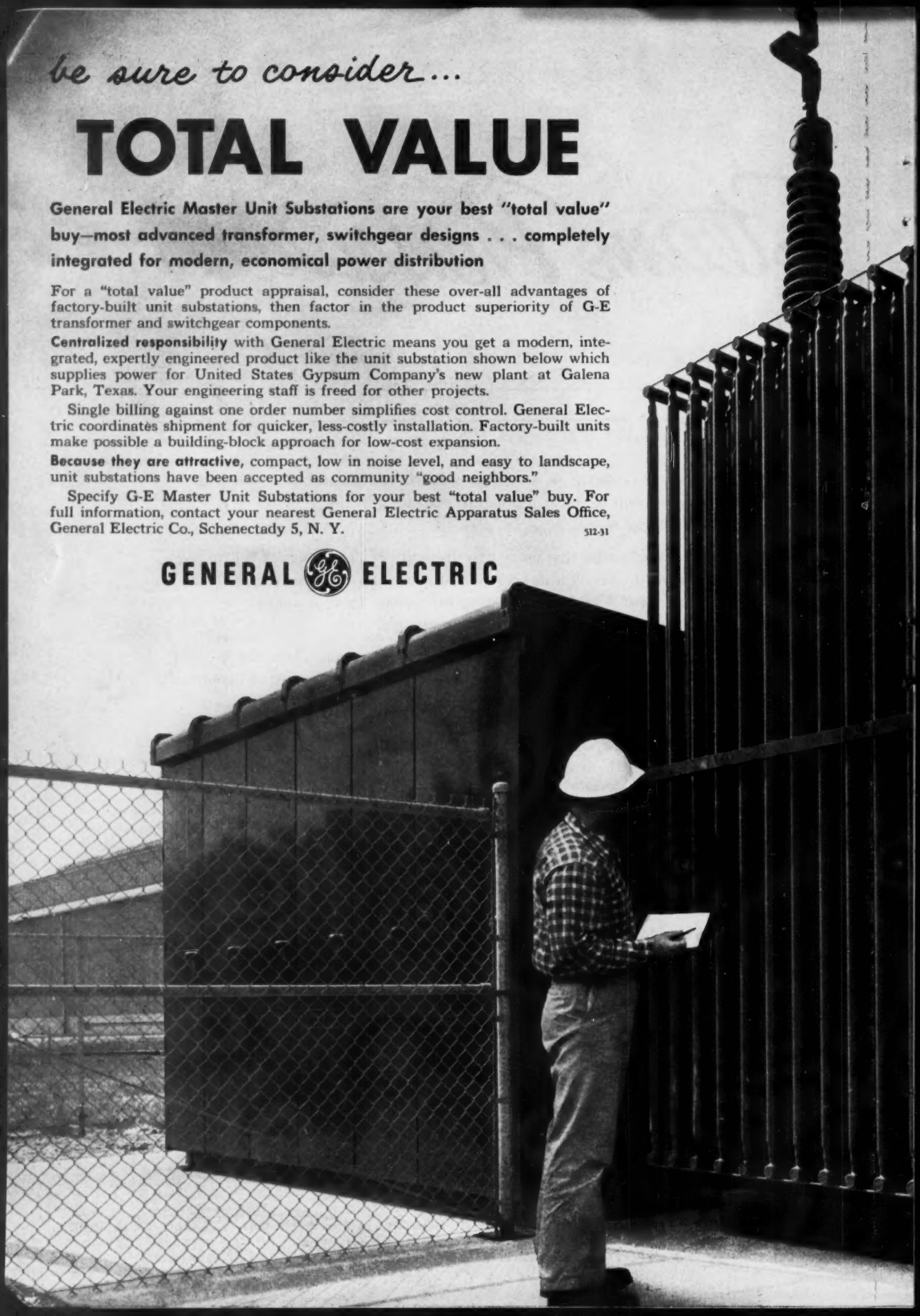
Single billing against one order number simplifies cost control. General Electric coordinates shipment for quicker, less-costly installation. Factory-built units make possible a building-block approach for low-cost expansion.

Because they are attractive, compact, low in noise level, and easy to landscape, unit substations have been accepted as community "good neighbors."

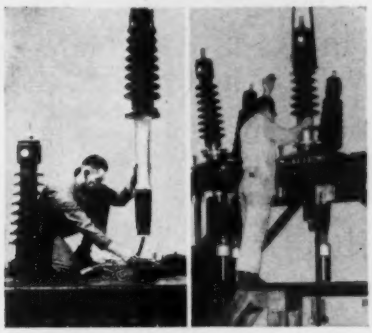
Specify G-E Master Unit Substations for your best "total value" buy. For full information, contact your nearest General Electric Apparatus Sales Office, General Electric Co., Schenectady 5, N. Y.

512-31

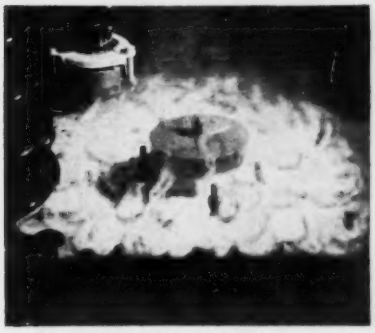
GENERAL ELECTRIC



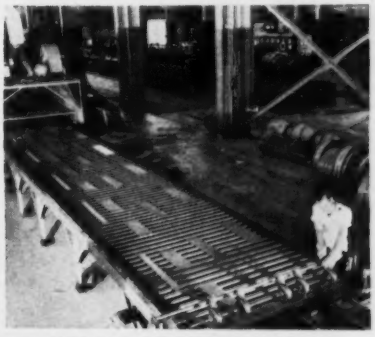
These transformer features are part of G-E Unit Substation value



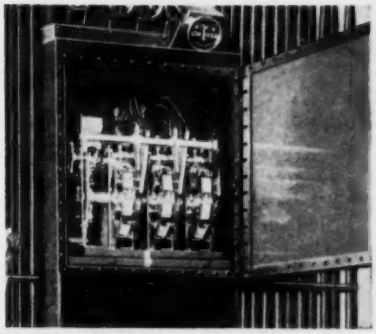
INTERCHANGEABLE BUSHINGS can be converted easily from transformer to breaker application to cut bushing inventory significantly.



PRESSURE-RELIEF DEVICE gives tank protection from excessive internal pressures. Direct-acting mechanical device is rugged, self-resealing.

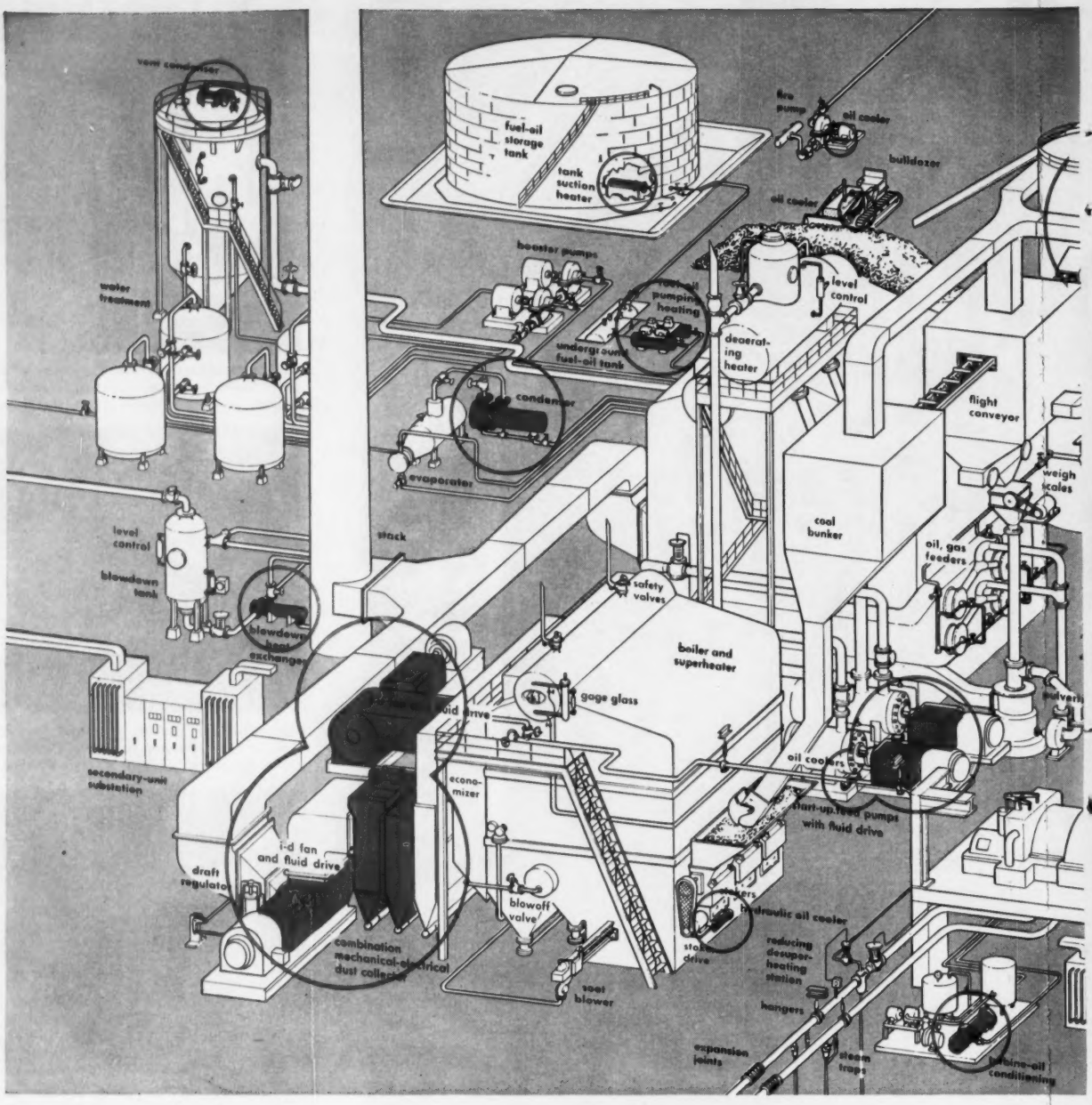


TEN PERCENT LOWER CORE LOSSES, sound levels 2 to 3 db below industry standards result from new core steel annealing process.



NEW LOAD TAP CHANGER cuts routine maintenance 50% by doubling contact-tip life. Peak operating noise is reduced 20 db.

circle 808 on Reader Service card, p 227



American-Standard Industrial Division products

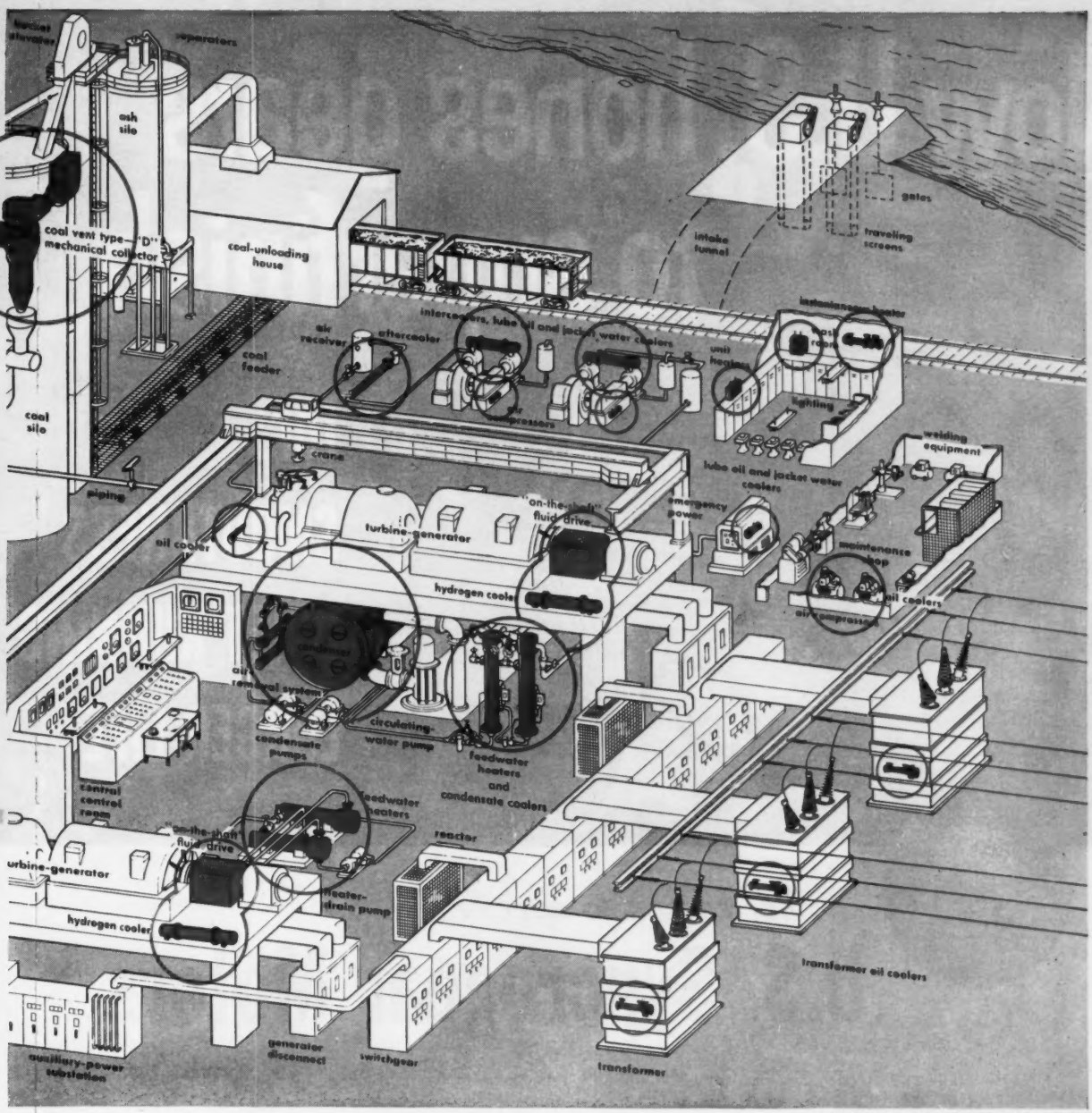
THIS LAYOUT of a modern steam power plant could be yours today or a blueprint of your future one. It could be a central-station or an industrial plant.

As you can see for yourself, American-Standard* Industrial Division products play a vital role — no matter what size plant you plan.

Standard or special, primary equipment or machine components, large or small, one of a kind or dozens alike — American-Standard Industrial Division products are designed and built for optimum performance in every type of service within the modern steam power plant.

An American-Standard Industrial Division product specialist in consultation with your engineer not only has much to offer in the way of equipment, but extensive experience as well. The combined product lines of American-Standard Industrial Division—American Blower, Ross Heat Exchanger, and Kewanee Boiler—are renowned in the power-generation field—utilities, industries, institutions, major buildings, engineering and contracting firms throughout the world.

AMERICAN-STANDARD INDUSTRIAL DIVISION, DETROIT 32, MICHIGAN. IN CANADA: AMERICAN-STANDARD PRODUCTS (CANADA) LIMITED, TORONTO, ONTARIO.



DRAWING COURTESY POWER MAGAZINE

perform numerous services in a modern steam plant

For information on specific products — or reprints of this advertisement — contact the American-Standard Industrial Division office nearest you.

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AMERICAN-Standard
INDUSTRIAL DIVISION

AMERICAN BLOWER PRODUCTS • ROSS PRODUCTS • KEWANEE PRODUCTS

For more facts circle 809 on Reader Service card, p 227

Now U.S. hones gears to superfinish

HOBBING gears is like SAWING WOOD. All gears are hobbed.

SHAVING gears is like PLANING. Some makers shave gears.

for: SMOOTHNESS QUIET RUNNING LONGER LIFE

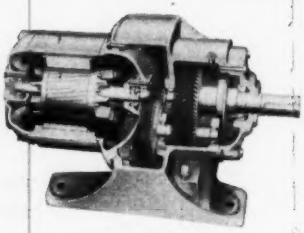
ONLY U.S. goes a step farther and HONES gears! That's like sanding for extra smoothness!

another reason to specify:

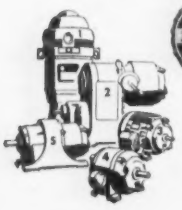
U.S. Syncrogear Motors

Among the makers of electric gearmotors, only one – U.S. Motors – *hones* gears to assure extremely accurate profile and smoothness. This honing means quiet running and longer life. Gear hobbing, the necessary first step in cutting gear teeth, leaves a degree of roughness analogous to sawing wood. Many gear makers go no further. Some, however, shave the gear teeth before hardening. This leaves a surface analogous to planing wood.

The ultimate refinement in tooth profiling, however, is honing – which may be likened to sanding of wood. This takes place *after* gear teeth are hardened. Thus, it takes out any imperfections and minor heat-treat distortions. It is to assure precision and exclusive refinements such as this that U.S. makes its own gears. Another good reason to specify: "U. S. SYNCROGEAR MOTORS." (⅓ to 50 H.P.)



SEND FOR FREE SYNCROGEAR MOTOR BROCHURE No. F-1880, *explaining the Syncrogear principle. Color illustrated.*



U.S. ELECTRICAL MOTORS INC.

P. O. BOX 2058
LOS ANGELES 54, CALIFORNIA
OR MILFORD, CONNECTICUT

U.S. MAJOR MOTOR LINES INCLUDE:
1. Vertical Solid & Holloshaft, 2. Varidrive, 3. Totally-Enclosed, 4. Uniclosed, 5. Syncrogear. Also, many other special motors.

For more facts circle 810 on Reader Service card, p 227

Now Available . . . . .

THE AUTOMATIC PLANT

. . . . . technology is ready, but close scrutiny of economics is essential

by W. W. Hopwood
President, Hagan Chemicals & Controls, Inc.

There is no question that most of the hardware for a computer-controlled power or process plant is available today—however, we feel that enthusiasm for this concept has led to a glossing over of the economics of the situation. In addition, as the art of computer control stands today, reliability requirements have been compromised.

We have taken these, and the many other factors which bear on the successful installation of computer control, into consideration in formulating our position, which is: Only as many steps towards complete computer control should be taken as can be justified both technically and economically. Since it is almost impossible to compute the dynamics of a process in advance of its operation, it is only logical to establish a sequence which will permit each step to be tested and justified before the next step is taken. Of course, if a specific situation requires it, the complete package can be installed at once. Here are the steps which we at Hagan feel are reasonable and economically sound:

1. Install a solid state electronic analog control system.
2. Install a solid state electronic scanning-logging data system.
3. Install computer capacity to compute from processed data.
4. Add programming capacity for automatic start-up and shut-down, as well as day by day operation.

Hagan equipment is designed to implement such a program. The Hagan PowrMag analog computer control system, featuring all solid state—magnetic amplifiers, requires minimum maintenance and provides a high degree of reliability and sensitivity with fast response. DC operation at the 1 to 9 volt level permits simple wiring, and the output is ideally suitable for use with the Kybernetes data processing-computing system.

We are ready, at this time, to take the computer control concept as far as the specific operation and management requirements determine.

Kybernetes put into operation at water works system in one day.

The Kybernetes system at an eastern water works *was installed and tested to be operational in one day.* Ninety-two inputs, representing flows, levels and pressures will be displayed as digital values on the main control console. In addition, two typewriters will print out the data for permanent records, and the system permits trend logging of selected variables without interfering with basic scanning. Alarm scanning of all incoming data is also performed automatically. If any variable exceeds preset minimum or maximum values, a visual and audible alarm alerts the operator to take corrective action. Installation test showed that the Kybernetes system was handling all available inputs.

Hagan PowrMag provides high reliability analog computer control

Utilizing magnetic amplifiers as the basic unit, the Hagan PowrMag system represents the most advanced electronic approach to industrial process control. Reliability and long, maintenance-free life are assured in every phase of the system, including inputs, analog computer-controllers, remote control stations and final control elements.

The PowrMag amplifier is a high gain, DC, magnetic amplifier composed of toroidal magnetic cores, windings and silicon diodes . . . all potted in epoxy resin and sealed

in a steel can—thus assuring reliability and long, tamper-proof life. Associated with the amplifier are remote control stations which provide the desired functions, and the whole unit may be mounted on panels up to ¼" thick, occupying only 2½" x 5¼". Utilizing a 1 to 9V DC input and output signal, the system is unaffected by stray AC, information is not deteriorated between measured variable and the final control element. Signals may also be fed to data processors or recorders without interfering with the control action.

PowrMag systems are currently being installed on (1) a 1,250,000 #/hr pulverized coal fired, divided furnace, controlled-circulation steam generation unit for a southern utility, (2) a 2,310,000 #/hr pulverized coal fired, single furnace, single drum, dry bottom reheat type steam generator for a midwest utility, and (3) a 1,700,000 #/hr 2400 psig, 1050°/1000° controlled circulation boiler at an eastern utility.

The Hagan PowrMag system is simple, yet extremely flexible in application. The basic elements are interchangeable, which limits stocking problems. Each element in the system is designed for long, trouble-free life, and adjustment of any loop is easy and exact. Here is the answer to the demand for a sensitive, accurate system with high stability and the utmost in reliability.

Kybernetes data processing system adds new flexibility

The new Kybernetes Series 2000 allows a new approach to the problem of scanning, logging, alarm scanning, computing, optimizing, programming and the many other uses to which data processing systems are put. Of modular construction and utilizing solid state components, the new Kybernetes features optimum reliability allied with such flexibility that a new dimension is added to data processing.

The basic system is a simple logging unit for recording process data on a log sheet or other output device. Because of its modular construction, this basic system can be expanded in both number of points handled and the complexity of the operations performed. This concept is in keeping with the Hagan approach to computer control, since any one or all of these functions may be added as it becomes desirable:

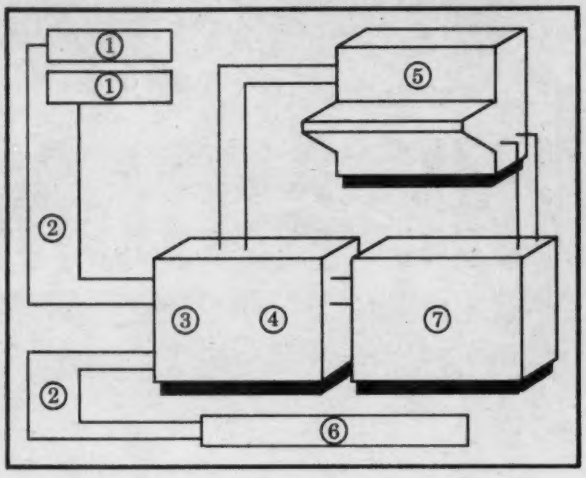
1. Alarm scanning.
2. Printed or visual trend logging of selected variables.
3. Computing or integrating.
4. Automatic programming and optimum setting of control.

With an accuracy of 0.1% on all inputs, the new Kybernetes reflects the simplified design logic which guided its design, and the reliability of all components is assured by the use of solid state devices.

In addition to numerous chemical, refinery and general process installations, a Kybernetes system will process data on the largest steam boiler in the world—a 3,850,000 #/hr unit now under construction at a southern utility.

Maximum usefulness with minimum investment characterizes this development. Field tested and proved, the new Kybernetes data processing unit will provide long, trouble-free operation.

The diagram illustrates a typical installation of Hagan PowrMag units in association with a Kybernetes data system for overall plant control.



1. Transducers convert measured variables into DC electrical signals and transmit to the central analog control computer via two-wire electrical cable. These signals may be recorded or indicated.

2. Two-wire, color coded cable, terminated with vibration-proof taper pin fittings, permits no-lag electric transmission of the measured process even in the largest plant. The system is designed so that the DC signal is, for all practical purposes, unaffected by stray AC potentials. The taper pin connections eliminate all field soldering or terminal box connections.

3. Signals enter plug-in patchboard section of analog computer. Patchboard is arranged to permit interconnection of system in any desired manner by simply moving taper pin connections.

4. PowrMag analog computer control elements are composed of operational magnetic amplifiers. They perform all the required control operations such as addition, subtraction, ratioing, integrating (reset), differentiating (rate), multiplication (proportional band), etc.

5. Remote control stations, located on the central control panel, provide process set point, bias, ratio, and other manually set control operations and have both output and null indicators.

6. Final control elements such as valve positioners, damper operators, saturable reactors, etc., receive the signal from the computer and act on the process function under control.

7. Series 2000 Kybernetes data processing system (see Bulletin MSP 161) can log, scan, trend log, read out, compute and integrate data as received from the PowrMag transducers, thermocouples, and other primary sensing elements. In addition, the Kybernetes digital computations can be used to return set point instructions to the PowrMag analog computer to optimize process controls.

For Bulletin MSP 161 (Kybernetes Data Processing Systems) and MSP 163 (PowrMag Electronic Control Systems), write to:

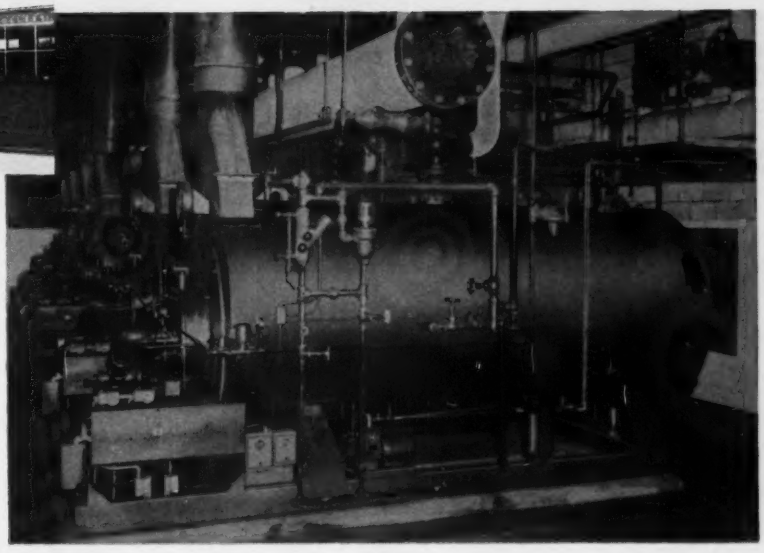
HAGAN CHEMICALS & CONTROLS, INC.

DIVISIONS: CALGON COMPANY, HALL LABORATORIES

HAGAN BUILDING, PITTSBURGH 30, PA.

In Canada: Hagan Corporation (Canada) Limited, Toronto
European Division: Via Flumendosa No. 13, Milano, Italy

Never more steam than you can use . . .
never less steam than you should have!



One of the largest producers of graders, roadscrapers and rolling equipment, Galion Iron Works & Manufacturing Co., has six 125 HP Cyclotherms now operating, plans to add a seventh and eighth as steam demands increase. Automatic operation has been the big factor in helping Cyclotherm make the grade with the graders!

Like GALION ESTABLISHED 1907 Iron Works, plan for tomorrow with

CYCLOTHERM!

With Cyclotherm Steam and Hot Water Generators, you buy steam capacity as you use it. No investment in excess capacity. No steam shortage with an outgrown boiler.

Cyclotherms give flexible capacity. You can add 518 lbs. of steam per hr. with a 15 HP Cyclotherm, or 25,875 lbs. per hr. with a 750 HP Cyclotherm. And there are 16 intermediate sizes to choose from.

AUTOMATIC OPERATION

Cyclotherms operate with automatic efficiency. On 15 to 60 HP units, burner automatically shuts down when steam demands are satisfied, automatically turns on when more steam is needed. On 80 to 750 HP units, modulation controls regulate firing rate from 30% to 100% of rated capacity, without loss of efficiency. Operation stops automatically if firing sequence is interrupted and unit "fails safe."

BUILT TOGETHER TO WORK TOGETHER

Cyclotherm burner and boiler are built together to work together — one manufacturing responsibility back of the entire equipment. Units are fire-tested at factory, shipped ready to operate. Cyclotherms are up to 1/3 smaller than other package boilers of same capacity. Installation is easy—no costly stack, no excavation, no foundation.

"CYCLONIC COMBUSTION"

"Cyclonic Combustion"—Cyclotherm's patented combustion principle—guarantees a minimum of 80% efficiency, meets all state requirements, conforms to A.S.M.E. and National Board standards, carries Underwriters' Laboratories label. Steam Generators from 15 HP to 750 HP, burn oil and/or gas. Hot Water generators in 10 capacities, from 670, 000 BTU per hr. to 6,700,000 BTU per hr.

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STEAM AND HOT WATER GENERATORS

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Please send me your booklet *Cyclotherm Cyclonic Combustion*, also rotogravure copy of *Cyclotherm Sales Steam* with illustrations and descriptions of Cyclotherm installations.

ALL SIZES, ALL BODY PATTERNS FOR ALL APPLICATIONS

BALANCED VALVES
— for air, steam, water, gas. Designed for applications where close control is required, where pressures exceed those of single-seated valves, and where tight closing is not required. Double-seated construction, approximately 98% tight closing. Sizes ½" to 14". Wide choice of models, capacities and operating features.

COIL VALVES
— for medium pressure steam, liquid, air or gas. Long-life molded rubber diaphragms. ½" to 6" sizes. Body patterns and features for many applications.

CONVECTOR VALVES
Compact size for installation in confined spaces, inside or outside convector enclosures. Models for low pressure steam, hot and cold water. All models have "Sylphon" metal bellows operators. Sizes ½" and ¾".

LIQUID VALVES
— for low pressure hot or cold water service. Choice of molded rubber diaphragms or seamless "Sylphon" bellows. Removable tops. Wide choice of features and body patterns. Sizes ½" to 8".

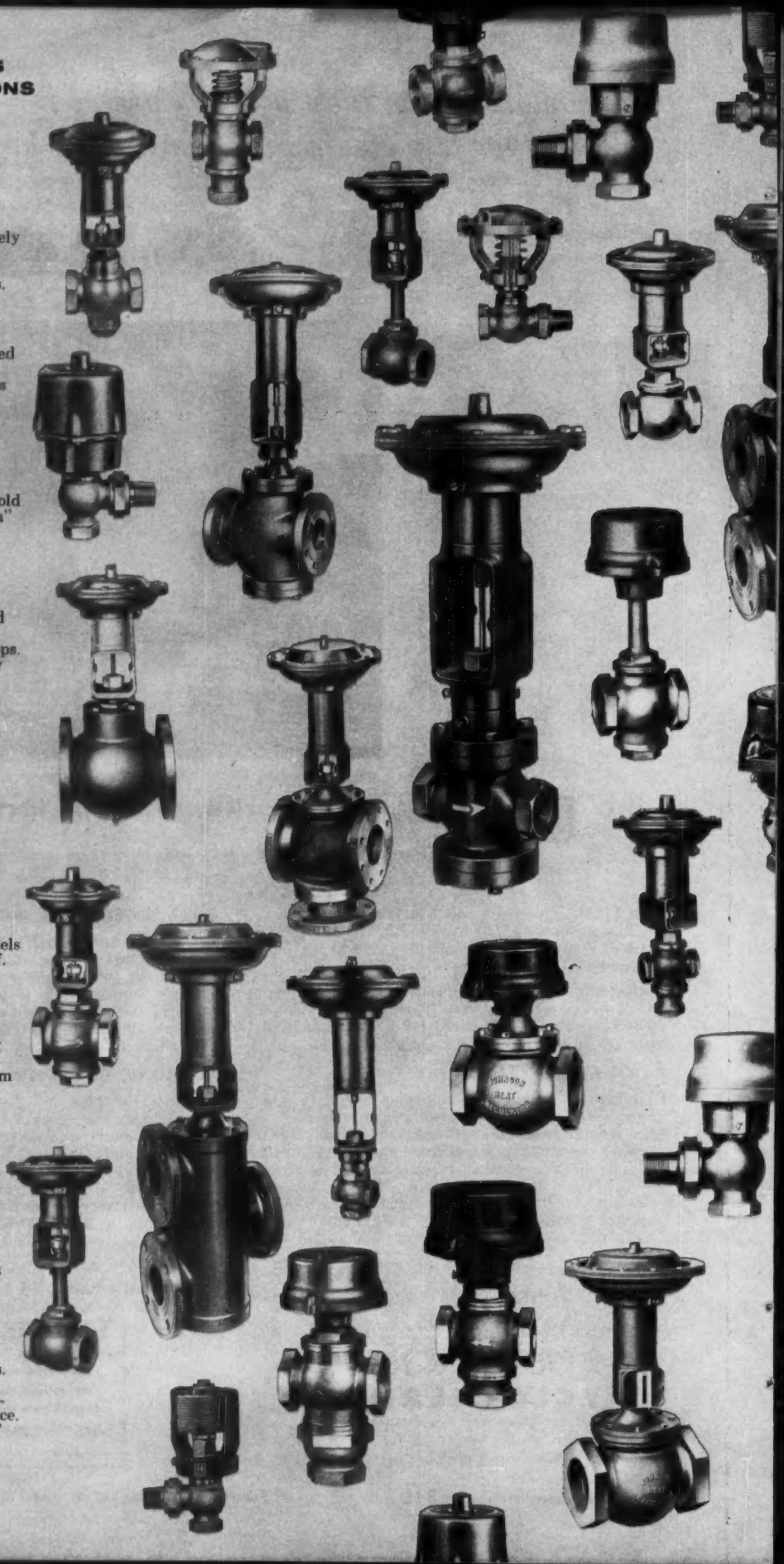
MIXING VALVES
— for applications requiring the mixture of liquids at different temperatures under control of a thermostat or humidostat. "Sylphon" and rubber diaphragm operators. Removable tops. Available in ½" to 10" sizes. Body patterns and operating features for every application.

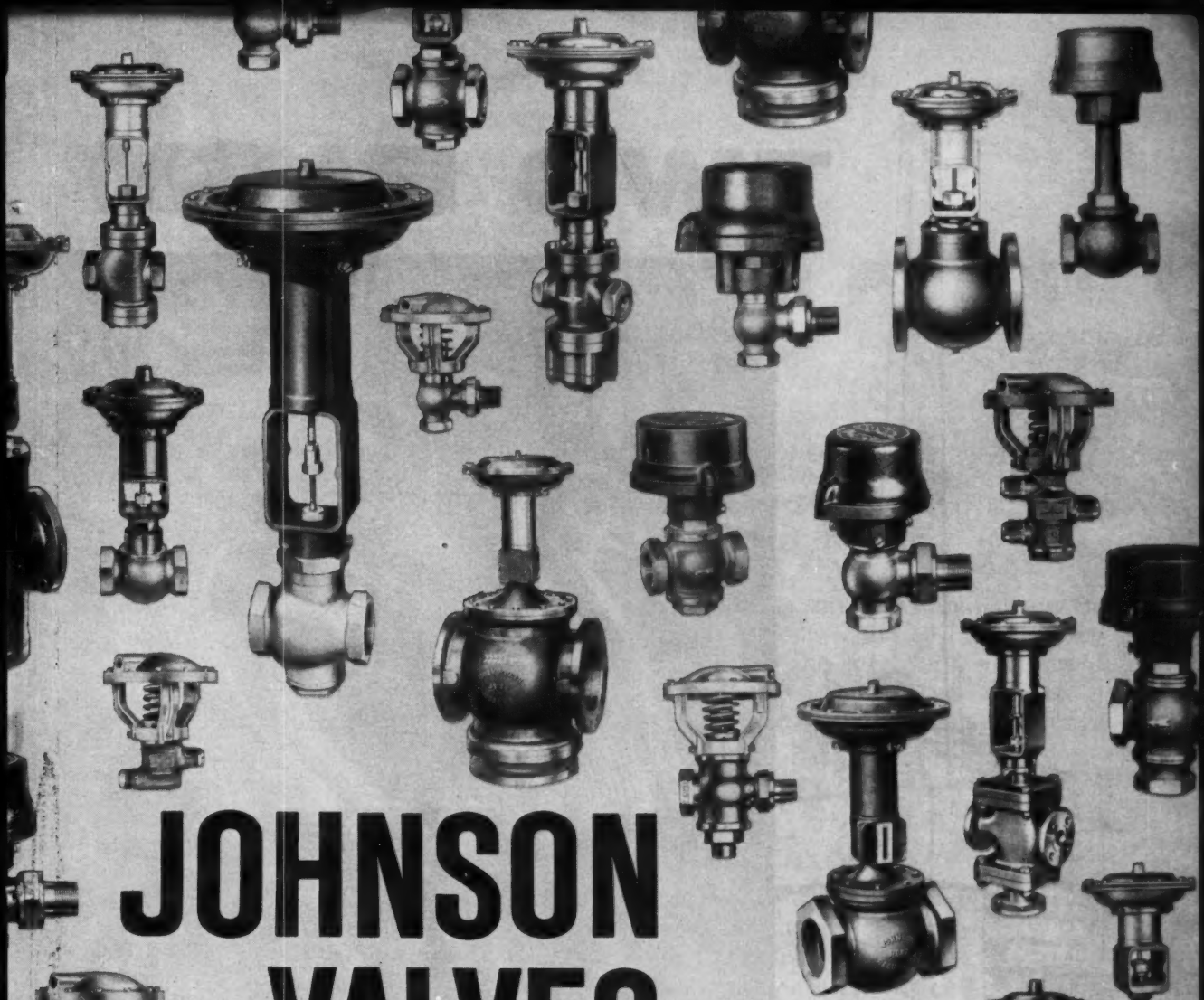
BY-PASS VALVES
— for control of liquids over a wide range of temperatures and pressures. Sizes ½" to 6". Models available with 100% tight shutoff. Removable operators.

WATER VALVES
— especially designed for use with small room air conditioning and heating units. High grade bronze bodies. Rubber diaphragm operators. Corrosion resistant throughout. V-ring self-sealing packing assures positive seal. Renewable composition discs. Sizes ½" and ¾".

STEAM VALVES
— for control of low pressure steam. Rubber diaphragm or seamless "Sylphon" operators. Renewable composition discs especially compounded for steam service. Sizes ½" to 10". Choice of body patterns and features.

BRINE VALVES
— for control at pressures up to 50 psi. Cast iron or bronze bodies. Rubber diaphragm or "Sylphon" operators. Renewable discs, especially compounded for brine service. Removable tops. Sizes ½" to 8" in a variety of body patterns.





JOHNSON VALVES FOR AIR, STEAM, LIQUID, GAS

The specialized Johnson organization has exactly the right valve for every possible air-conditioning, heating, or ventilating control system application. In fact, Johnson makes the most complete line of pneumatic equipment in the industry — for solving any problem of temperature, humidity, or pressure control.

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507 East Michigan St., Milwaukee 1, Wisconsin

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☐ Send your new condensed catalog of all types of Johnson Pneumatic Control equipment.

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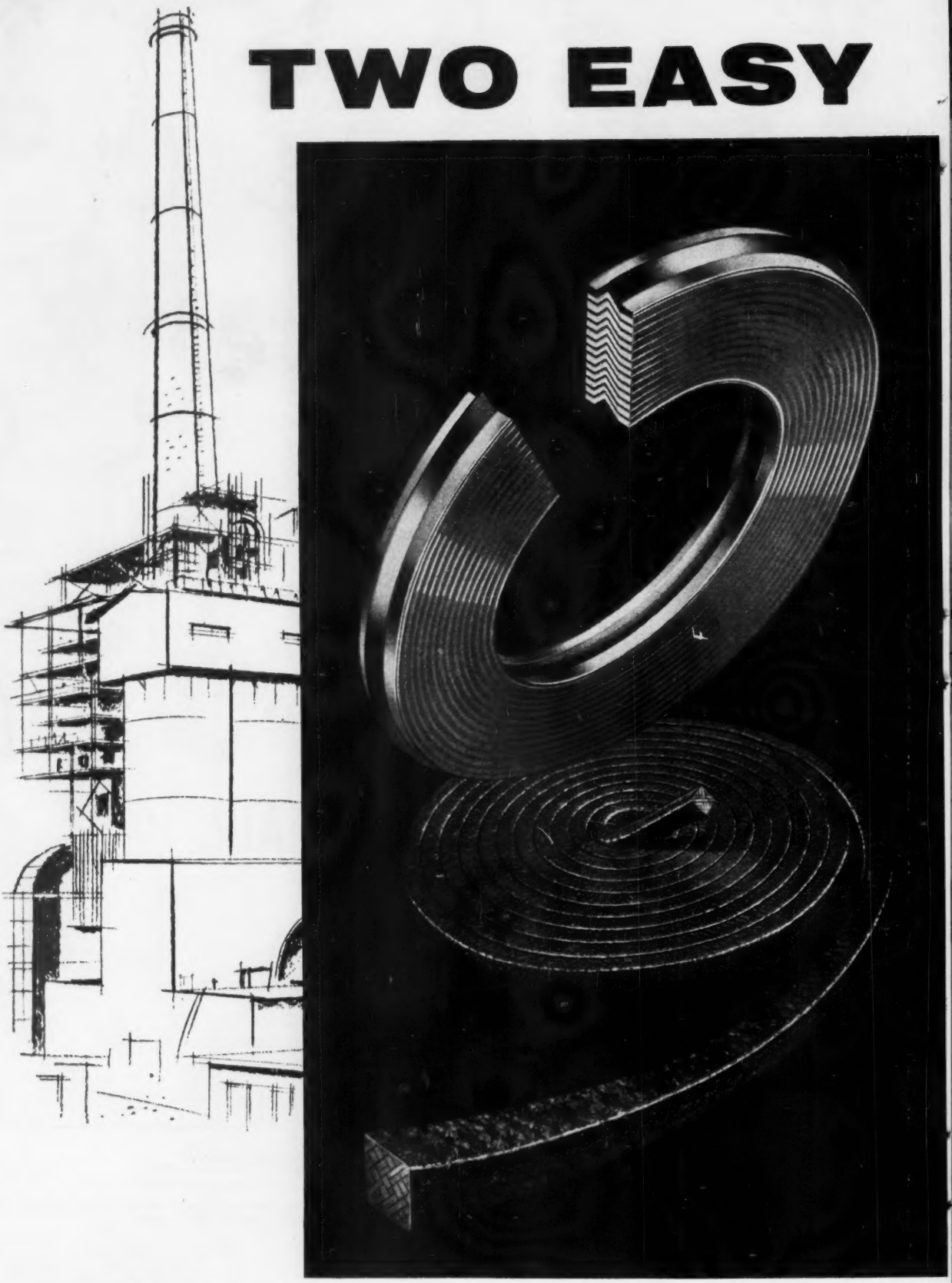
Title .....

Firm .....

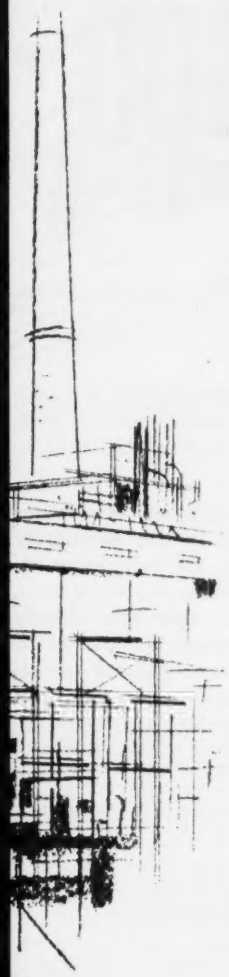
Address .....

City ..... State .....

TWO EASY



WAYS TO REDUCE POWER PLANT MAINTENANCE



Now, more than ever, power engineers and maintenance men specify Garlock GUARDIAN* Gaskets and LATTICE-BRAID* Asbestos Packings for safe, long lasting prevention of equipment failure due to high pressures and temperatures. Here are their reasons:

GARLOCK GUARDIAN GASKETS

adjust themselves automatically to maintain positive seal when pressures and temperatures change. No need to retighten bolts periodically. They are constructed of spiral wound strips of V-shaped steel, alternated with layers of asbestos . . . this enables GUARDIAN Gaskets to "spring" back to shape after compression. Also permits using lower bolt loads. Use them on boiler manholes, handholes, tube plates, and pipe flanges, where pressures rise as high as 2500 psi, temperatures to 1050° F. Available in round, oval, square, oblong, diamond, and pear shapes; practically any size and in thicknesses $\frac{1}{8}$", .175", and $\frac{1}{4}$". Write for Catalog AD-104.

GARLOCK LATTICE-BRAID ASBESTOS PACKINGS

require less gland pressure than conventional packings; accordingly, they require adjustment less often. Moreover, LATTICE BRAID outwears all conventional packings thus reducing downtime for repacking. Why? Because LATTICE-BRAID is made of a through-and-through braided construction; each strand passes diagonally through the packing body at a 45° angle, resulting in a unified structure of greater strength. The strands hold together even when the packing is worn far beyond the limits of ordinary braided packings. Next time, repack reciprocating rods or pump shafts with LATTICE-BRAID. See for yourself why so many others use LATTICE-BRAID asbestos packing against steam, oils, gases to 700° F. Write for Catalog AD-131.

Both these products are part of the Garlock 2,000 . . . two thousand different styles of packings, gaskets, and seals for every need. The only complete line . . . that's why you get unbiased recommendations from your local Garlock representative. Call him for further information.

THE GARLOCK PACKING COMPANY, Palmyra, N. Y.

For Prompt Service, contact one of our 2L sales offices and warehouses throughout the U.S. and Canada.

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GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products

CANADIAN DIVISION:
The Garlock Packing Company of Canada, Ltd.

PLASTICS DIVISION:
United States Gasket Company

For more facts circle 814 on Reader Service card, p 227

APPLIED EXPERIENCE

is an invaluable design factor of every

MARLEY CLASS 600 DOUBLE-FLOW

The future of an industrial cooling tower is no better than its background. Its performance and service life are dependent wholly on the practical experience and specific product knowledge of the people who design it. This suggests that you consider people as carefully as you consider price if you are to receive full-value returns from your investment.

When you buy a Marley Double-Flow, qualified people and abundant experience are basic parts of your purchase. You contract for the services of the industry's largest staff of engineering specialists, and each member—from years of specialization in thermal performance, structural and mechanical design, or application economics—contributes materially to the *true* value of the product you buy.

Of equal importance is the company's overall experience gleaned from designing and building 6,854 fan cells of large capacity industrial Double-Flows in the last 21 years . . . the sound basis of all Marley engineering. The only adequate file of authentic information on cross-flow cooling is the service history of all these installations. It evaluates every advancement and innovation in cross-flow cooling and, of course, is available only to Marley engineers.

At its Research Center, the company accelerates the acquisition of experience. In this excellently equipped facility, 30 engineers and technicians intensively test and analyze materials, equipment, components, complete towers; they scientifically appraise the value of theoretical approaches to new standards of cooling performance and operating economy. From experience gained through this program, Marley develops the steady flow of design advancements that pace the industry.

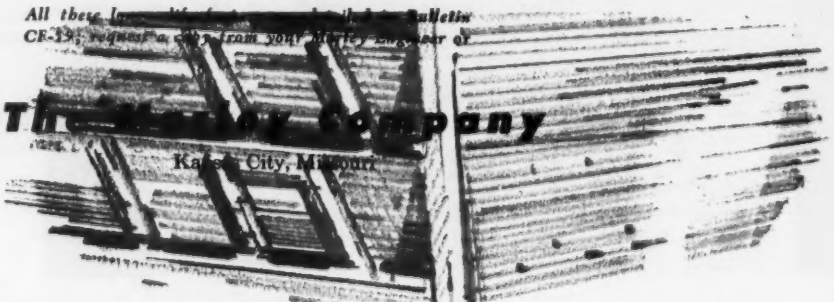
The ability of Marley people to apply their extensive experience to cooling tower design is demonstrated by the results of tower tests made public annually. Year after year, they prove that Marley Double-Flows — THE ONLY TOWERS WITH A PUBLISHED RECORD OF PERFORMANCE—consistently meet the most exacting specifications of purchasers in every industry.

All there l... Bulletin CE-13; request a ... from your Marley Engineer or

MARLEY

The Marley Company

Kansas City, Missouri



For more facts circle 815 on Reader Service card, p 217

for this type service . . . specify this **STRONG** *trap:*

Dirty Lines or Dirty Steam:

Lowest Initial Cost per pound capacity:

Lowest Initial Cost per pound weight:

Eliminating Large Volumes of Air:

Low Pressures with some air elimination:

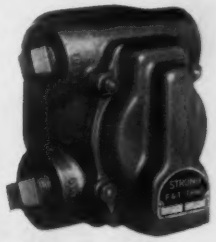
Pulsating or Widely Varying Pressures:

Continuous flow required:

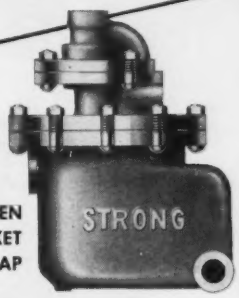
Draining a line carrying a vacuum discharging to atmosphere:

Draining a line carrying a vacuum or very low pressure discharging against a hydrostatic head or back pressure:

HYDRO-FLEX INVERTED BUCKET TRAP



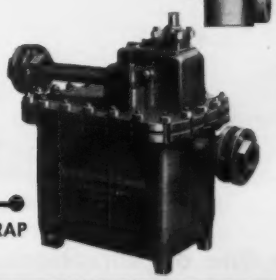
FLOAT & THERMOSTATIC TRAP



OPEN BUCKET TRAP

BALL FLOAT TRAP

TYPE "A" VACUUM TRAP



TYPE "M" VACUUM TRAP

on every type service

STRONG steam traps give you longer life, less maintenance

Strong offers six types of steam traps to answer every requirement for removing condensate from all types of systems.

You can specify these Strong Traps with the assurance that you will get maximum service life. Proof is the fact that replacement parts are still being ordered for traps sold 50 years ago!

Here are some low maintenance features built into Strong Traps. Screwed-in, replaceable valves and seats of wear-resistant ANUM-METL. Deep-drawn, one-piece stainless steel buckets. Extra-heavy body and cover construction. Thorough testing. Interchangeable parts.

You will be money and years ahead when you specify Strong Traps. For further information, contact your local Strong distributor — he carries complete stocks and replacement parts, offers prompt service.

Selector Chart in Strong Catalog No. 69A gives trap recommendations for 45 types of equipment. Write for your copy or call your distributor.

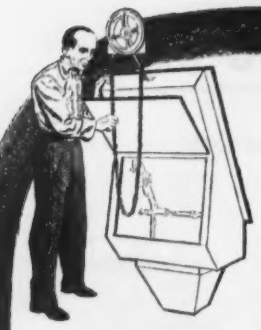
4/S

STRONG, CARLISLE & HAMMOND

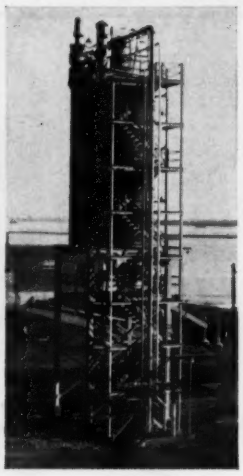
508 Sandusky Street • Conneaut, Ohio

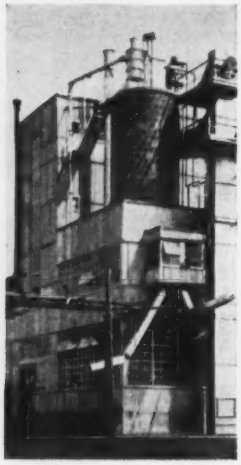
steam traps • air traps • float traps • vacuum or pumping traps
F and T traps • continuous blowdown valves • separators • engine stops

For more facts circle 816 on Reader Service card, p 227

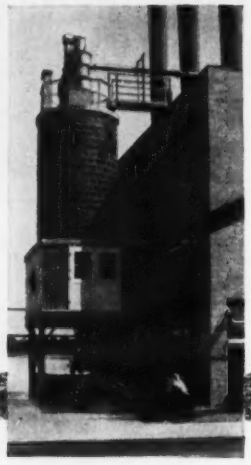


100 ton Ash Silo straddling R.R. track with full stairway to roof. High capacity Ash Conditioner on open platform with discharge to R. cars.





Ash Silo constructed integrally with boiler house. Ash Conditioner mounted inside building. Bifurcated chute allows R.R. car or truck loading.



Ash Silo for truck loading with enclosed room for ash conditioner.

American Cyanamid Co.
American Gas & Electric Service Corp.
American Sugar Refining Co.
Calvert Distillers
Carrier Corp.
Central State Hospital of Virginia
Chemstrand Corp.
Chicago Pneumatic Tool Co.
Cluett-Peabody Co., Inc.
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General Foods Corp.
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Hoover Company
Indiana University
Kelsey-Hayes Wheel Company
John A. Manning Paper Co.
Marion Power Shovel Co.
Mergenthaler Linotype Co.
National Distillers
Charles Pfizer Co.
Pittsburgh Plate Glass Co.
Public Service Electric & Gas Co.
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Riegel Paper Corp.
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Stauffer Chemical Corp.
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Villanova College
Wake Forest College

These fine organizations, and hundreds like them, choose National for

ASH REMOVAL AT LOWER COST

Interested in Ash Conveying equipment? Ask your nearest *National* representative to show you, without obligation on your part, how costs can be cut with a National Steam-operated Pneumatic, Hydraulic or Motor-driven System. National offers a nation-wide installation service – high operating efficiency – rugged, wear-resistant pipe and fittings that provide lower maintenance cost per ton of ash conveyed. Consult National now – one contract covers everything, from inception to finished installation. Write us, or nearest representative listed below.

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Bulletin P57-A
on pneumatic ash conveyors

Bulletin H57
on hydraulic ash conveyors

National
CONVEYORS
COMPANY INC.
FAIRVIEW, BERGEN COUNTY, N. J.
WHitney 5-9136

Also manufacturers of: **National ChipVeyor Systems** for the collection and processing of metal chips and borings and reclamation of cutting oils (Send for Bulletin C-56). **Conveyors** for press scrap and small parts and **Pneumatic Systems** for handling dry granular materials (Bulletin P-58G).

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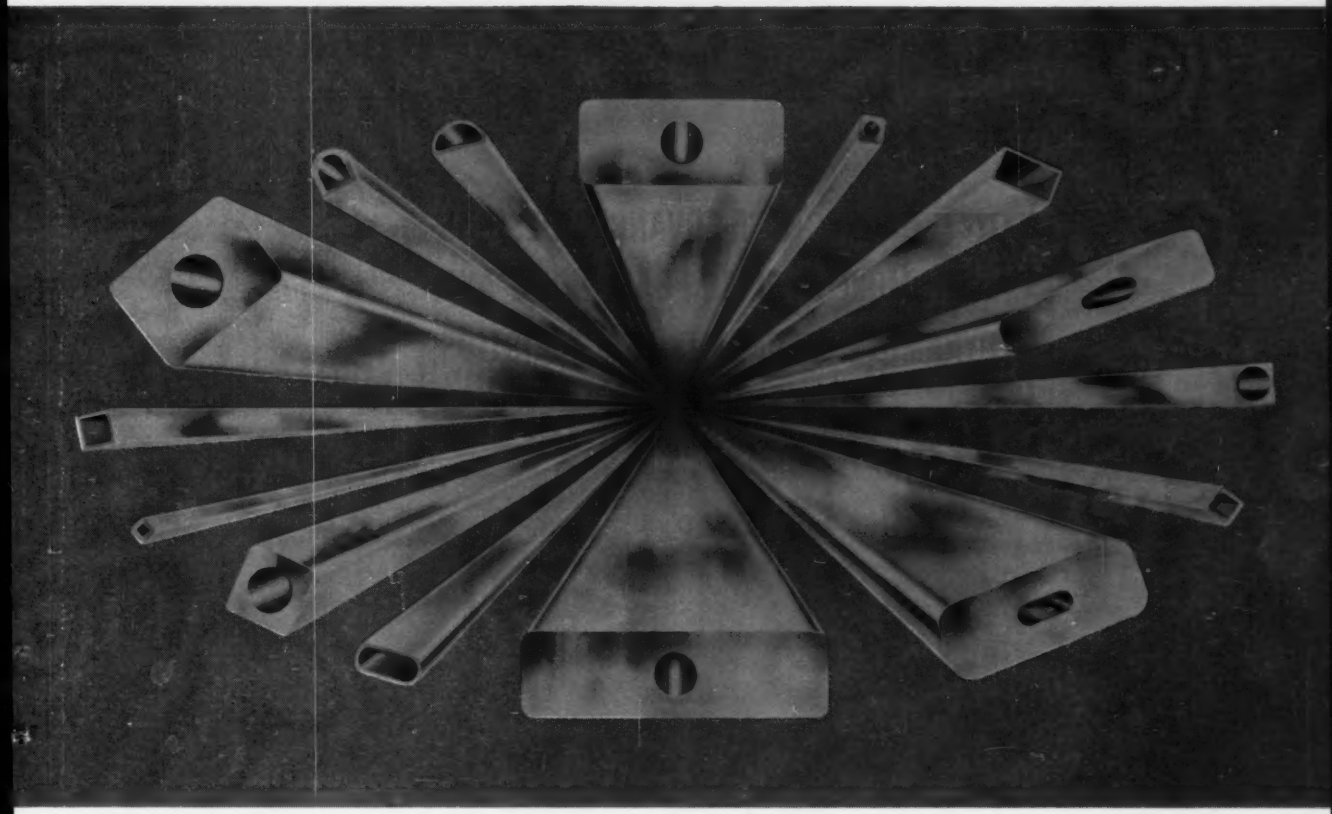
For more facts circle 817 on Reader Service card, p 227

THE SHAPE OF THINGS TO COME WITH ANACONDA ELECTRICAL COPPER



Fluid-cooled copper conductors. The growing need for compact electrical assemblies which can handle high current densities is leading to an ever-increasing variety of hollow, fluid-cooled copper conductors. The samples shown about three-quarters full size above give some idea of the range of sizes and shapes produced by The American Brass Company.

Nuclear physics magnets are, perhaps, the most spectacular applications of fluid-cooled conductors. These hollow conductors range from tube .182" square O.D. x .083" square I.D. to heavy rectangular bars with a round core for water cooling.

Industrial applications. The use of fluid-cooled conductors is growing rapidly in large electrical equipment. Generator output can be greatly increased, without increasing frame size, by cooling stator and rotor bars. Fluid-cooled conductors are being used in heat sinks for rectifiers and induction furnace coils. Another interesting use is in compact water-cooled windings needed to provide very high flux densities in, for example, the ceramic magnet manufacturing process. These "solenoids" are being built for applications in which the current range is from a few hundred to about 2000 amperes.

Technical assistance. Whatever your problem —liquid-cooled field coils, rotor bars or a special-shape tubular conductor—technical specialists at The American Brass Company will gladly help you work out the size and shape best adapted to your needs. See your American Brass representative or write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. 5042A

ANACONDA®

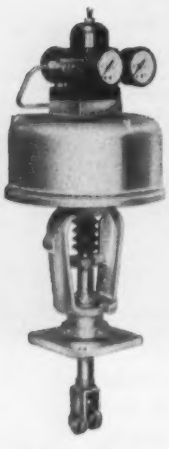
ELECTRICAL COPPER PRODUCTS

Made by The American Brass Company

For more facts circle 818 on Reader Service card, p 227

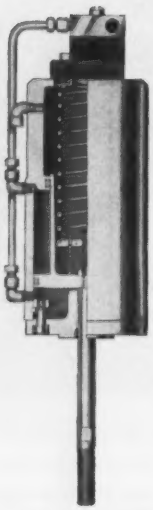
Annin OFFERS YOU MORE IN ACTUATORS

Your choice OF ADVANCED DESIGNS WITH MORE PRECISE POSITIONING AND DYNAMIC RESPONSE CHARACTERISTICS



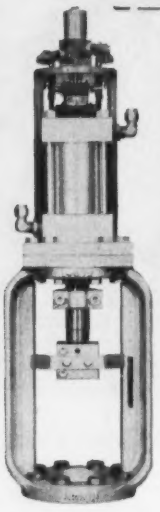
1542 & 1544 SERIES DOMOTOR POWERED ACTUATORS

Two types, "Direct Thrust" (illustrated) or "Lever" units are available for any application requiring accurate positioning in response to a pneumatic signal, such as butterfly valves, dampers, turbines and engine governors. Guaranteed positioning accuracy of better than 0.001" per inch of stroke over the complete range of piston travel is combined with a smooth operating action that provides an accurate, stable output force.



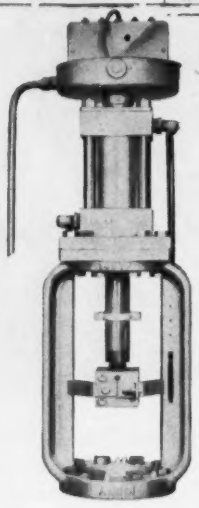
600 SERIES STROKE POSITIONING ACTUATORS

Offered primarily for the control of variable speed drives, rheostats, pumps and cams, as well as control valves, with strokes up to 6 inches and forces up to 2510 pounds of thrust. Compact and rugged, for easy mounting on existing equipment. May be operated from a standard 3-15 psi instrument signal, with a positional accuracy within 0.001" per inch of stroke.



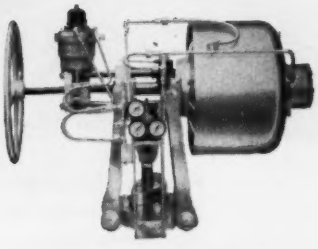
10,000 SERIES PNEUMATIC-HYDRAULIC ACTUATORS

For valves requiring strokes to 6 inches and thrusts to 100,000 lbs. Furnished on body assemblies where process conditions require very fine valve response, hi-speed and stability. Operate on 1500 psi oil supply system from any common instrument air signal.



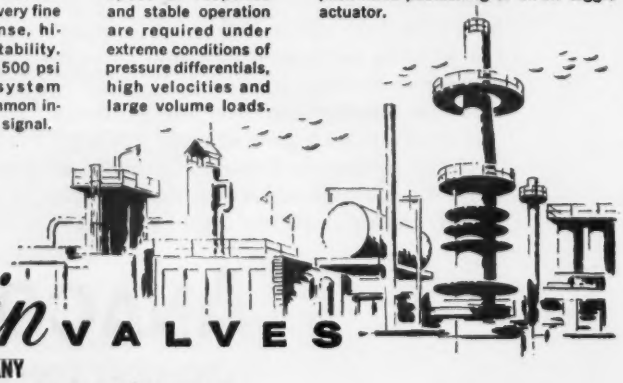
20,000 SERIES ELECTRO-HYDRAULIC ACTUATORS

Provide a means of converting an electrical signal to a powerful hydraulic positioning force, where high speed of response and stable operation are required under extreme conditions of pressure differentials, high velocities and large volume loads.



TOGGLE ACTUATORS

For process requirements where the unbalanced forces are extremely high, or where large through-puts are required. Three types are offered: pneumatic positioning, pneumatic on-off, and manual control, all embodying the toggle actuator; or a manual control arrangement can be combined with the pneumatic positioning or on-off toggle actuator.

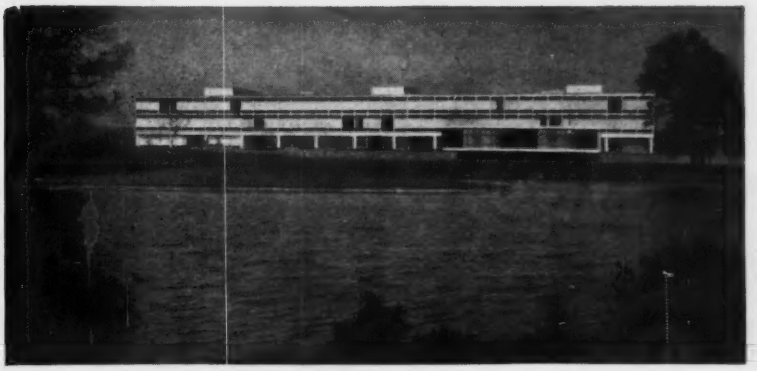


Annin VALVES

THE ANNIN COMPANY
1040 S. Vail Avenue, Montebello, California

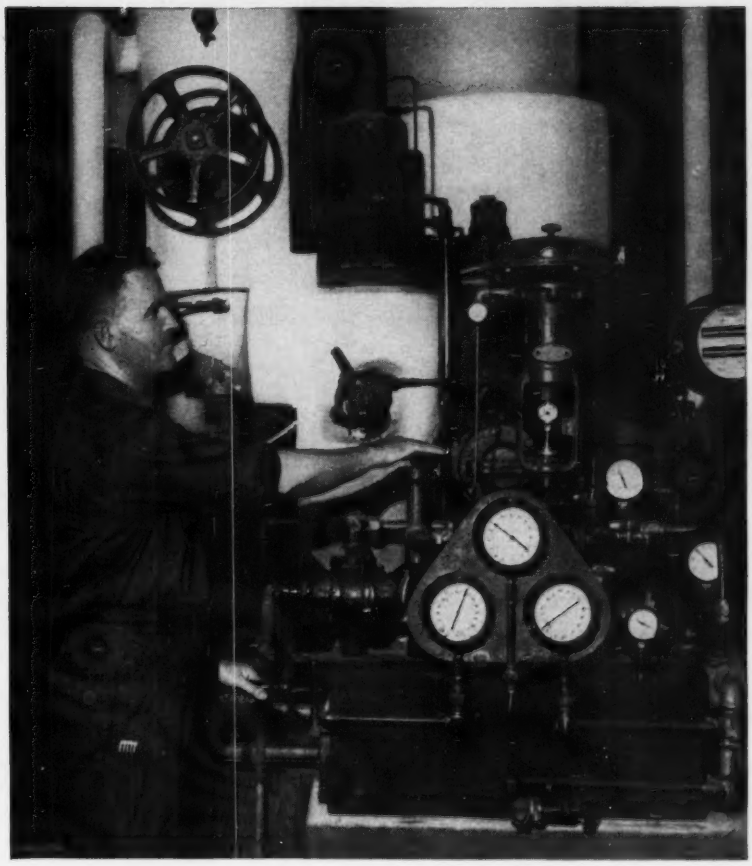
Write for Bulletin 1236-ST

For more facts circle 819 on Reader Service card, p 227



New home office for Connecticut General Life is a modern structure five miles out in the country.

Terry turbines power air-conditioning system at new Connecticut General Life building



One of two 870-hp, 3970-rpm Terry turbines built to drive the refrigeration compressors.

The new home office of the Connecticut General Life Insurance Co., in suburban Hartford, represents the best in contemporary architecture as well as construction techniques and materials.

In keeping with the careful planning evident throughout the project, two Terry turbines were selected to drive the York centrifugal refrigeration compressors. Terry turbines such as these have a record of low maintenance and consistent reliability under varied conditions. The steam generators, which are used for general heating during the winter months, furnish the power to operate the turbines. This provides an economical and dependable air-conditioning setup.

The steel and glass building accommodating 2500 employees overlooks New England farmland. It is furnished with modern equipment, to step up the efficiency of clerical work. Other amenities: lounges, game rooms, cafeteria, bowling alleys, barber and beauty shops, variety store, medical department.

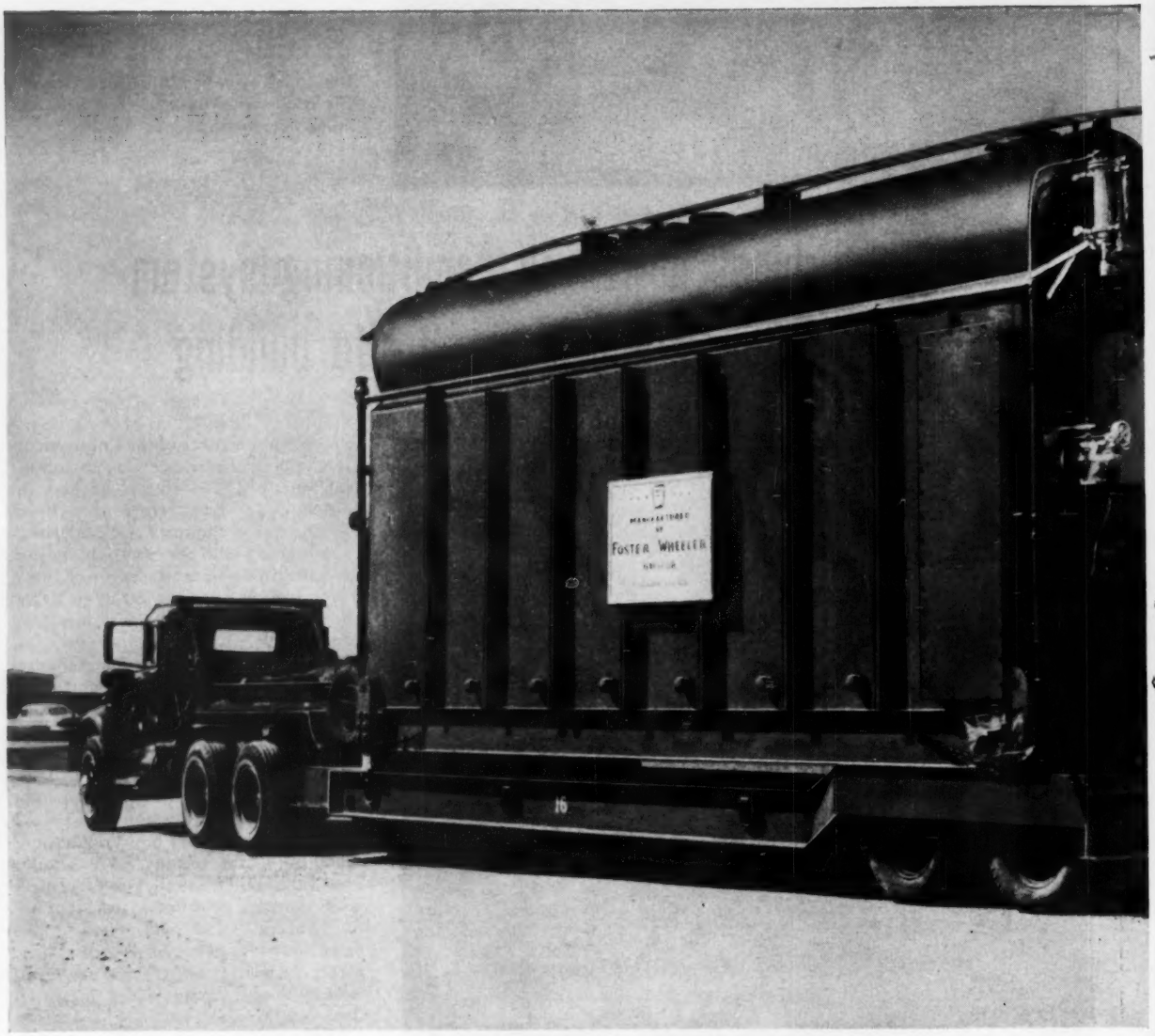
If you are planning an air-conditioning system, perhaps you, too, should consider steam-turbine drive. Write for detailed information about the advantages of turbines for your specific requirements.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1213

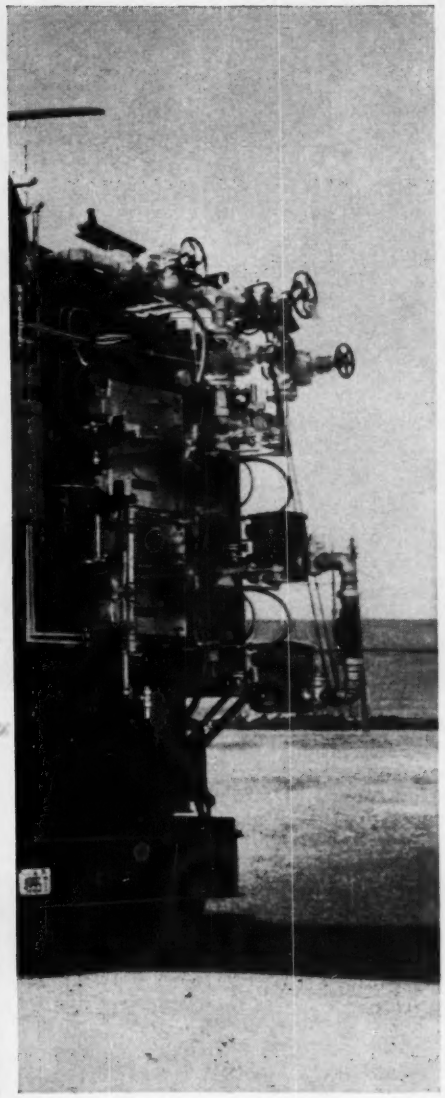
For more facts circle 820 on Reader Service card, p 227



Foster Wheeler Packaged Steam Generator on its way to a refinery, where it is now producing 50,000 lb/hr of high-purity steam for processing and heating purposes.

—PETROLEUM PROCESSING

—CHEMICAL PROCESSING



Foster Wheeler delivers the steam you need and the economy and efficiency you want, in one package

If you need 13,000 lb/hr or more of steam at pressures of 250 psi or above, one of the best ways to begin planning your steam generator installation is by contacting Foster Wheeler right now.

This is Foster Wheeler's record of experience in meeting steam requirements with packaged steam generators.

The first water tube shop-assembled packaged unit was built by Foster Wheeler in 1940, to solve an important defense problem. Today, standard Foster Wheeler Packaged Steam Generators, firing fuel oil and gas separately or in combination, are serving refineries, process and manufacturing plants, hotels, dairies . . . virtually every type of business and industry throughout the world.

Most recent Foster Wheeler development in packaged steam generators is a stoker fired model, the first available to industrial users of steam.

In short, the *heat engineering* experience that goes into Foster Wheeler Packaged Steam Generators is unique in the power industry. And the result is a product engineered for dependable, economical and efficient production of high-purity steam . . . and delivered as a package which keeps installation costs to a minimum.

Make planning your steam generator installation easier by getting full information on Foster Wheeler Packaged Steam Generators *before* you start writing your specifications. Write Foster Wheeler Corporation, 666 Fifth Ave., New York 17, for Bulletin PG-58-2. Or better still, contact Foster Wheeler directly and discuss your steam requirements personally with one of Foster Wheeler's *heat engineering* specialists.

Heat Engineered products, plants and processes . . . for the world's power, petroleum and process industries.

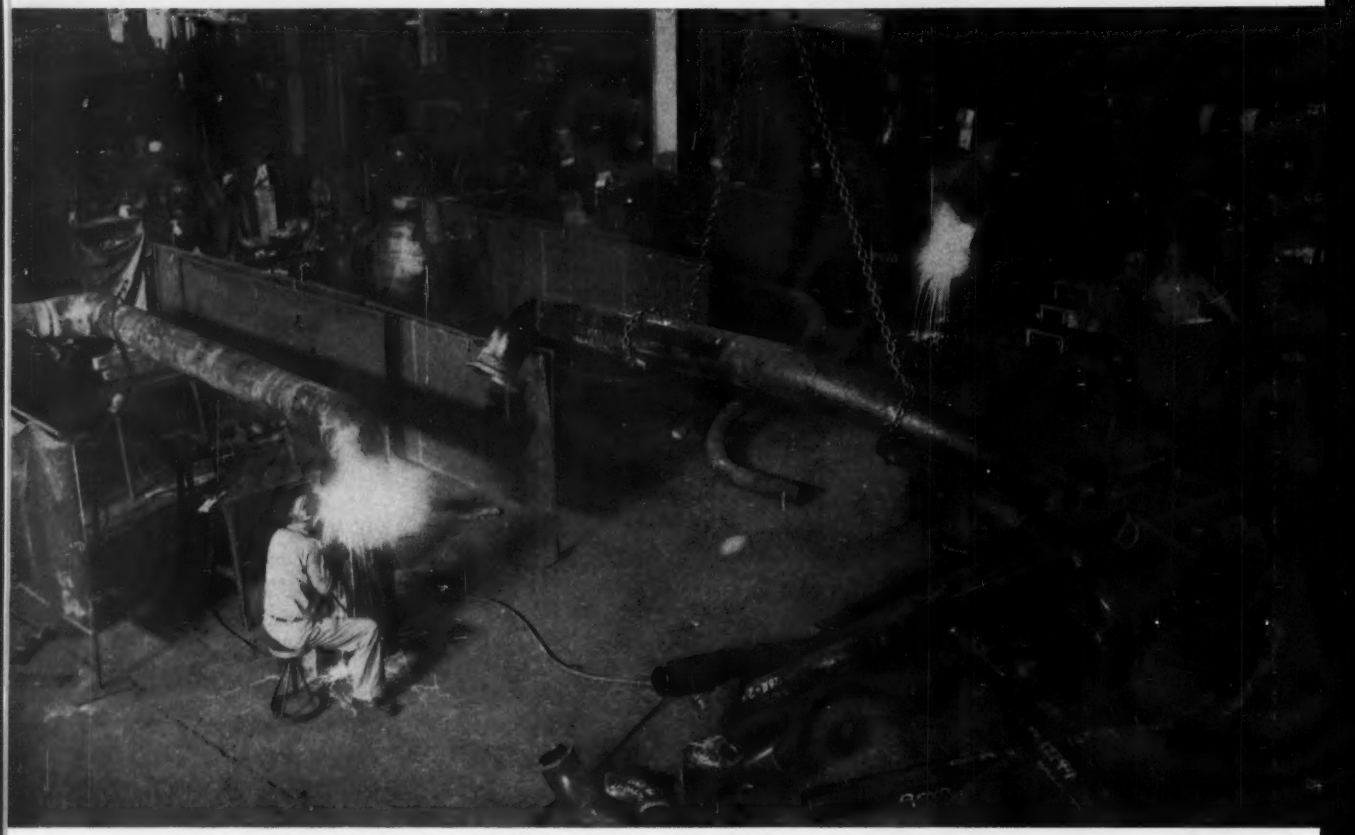
—SPECIALIZED INSTALLATIONS

FOSTER WHEELER

NEW YORK LONDON PARIS ST. CATHARINES, ONT.

For more facts circle 821 on Reader Service card, p 227

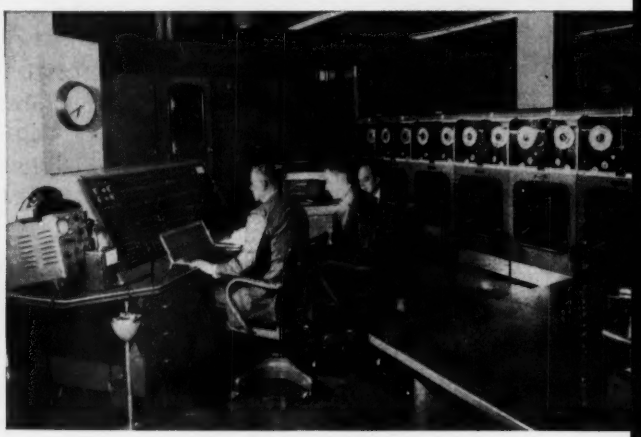
How Blaw-Knox cuts your power piping costs



121,000 square feet of space at your service. Power piping facilities at Pittsburgh include 56,000 square feet of plant area and an additional 65,000 square feet for exterior storage. An additional new plant is located on a 15-acre site in Jackson, Mississippi.

Your job is under the personal supervision of an experienced engineer, who follows your project from beginning to end. Your piping is handled with the most modern equipment for welding, heat treating, and bending. Fabricating techniques, proven by rigid testing, are used.

New product development. Blaw-Knox developed an enclosed type of functional spring hanger as part of their complete line of hangers for supporting any piping system. Here a group of hangers individually designed for a project is factory checked to assure fast field erection.



Stress calculation cut from months to a day . . . with pace-setting engineering. An exclusive Blaw-Knox method uses an electronic computer for automatic computation with no limitation on the complexity of system. Full accuracy, with tremendous savings in time and cost. Write for details.

BLAW-KNOX

BLAW-KNOX COMPANY
Power Piping Division
829 Beaver Avenue, Pittsburgh 33, Pennsylvania

For more facts circle 822 on Reader Service card, p 227

THE PROPER WIND IN SPIRAL-WOUND

It's the precise control of gasket densities for every stage in the pressure series that makes each Flexitallic Gasket right for a given flange.

Flexitallic Spiral-Wound Gaskets are engineered to meet extreme conditions encountered in keeping with the pressure/temperature rating for the specified assembly.

These controls mean that a Flexitallic Gasket, designed for an extreme pressure/temperature rating, is never so soft that it crushes under the specified load, and never so hard that it resists the compression necessary for a specified seal.

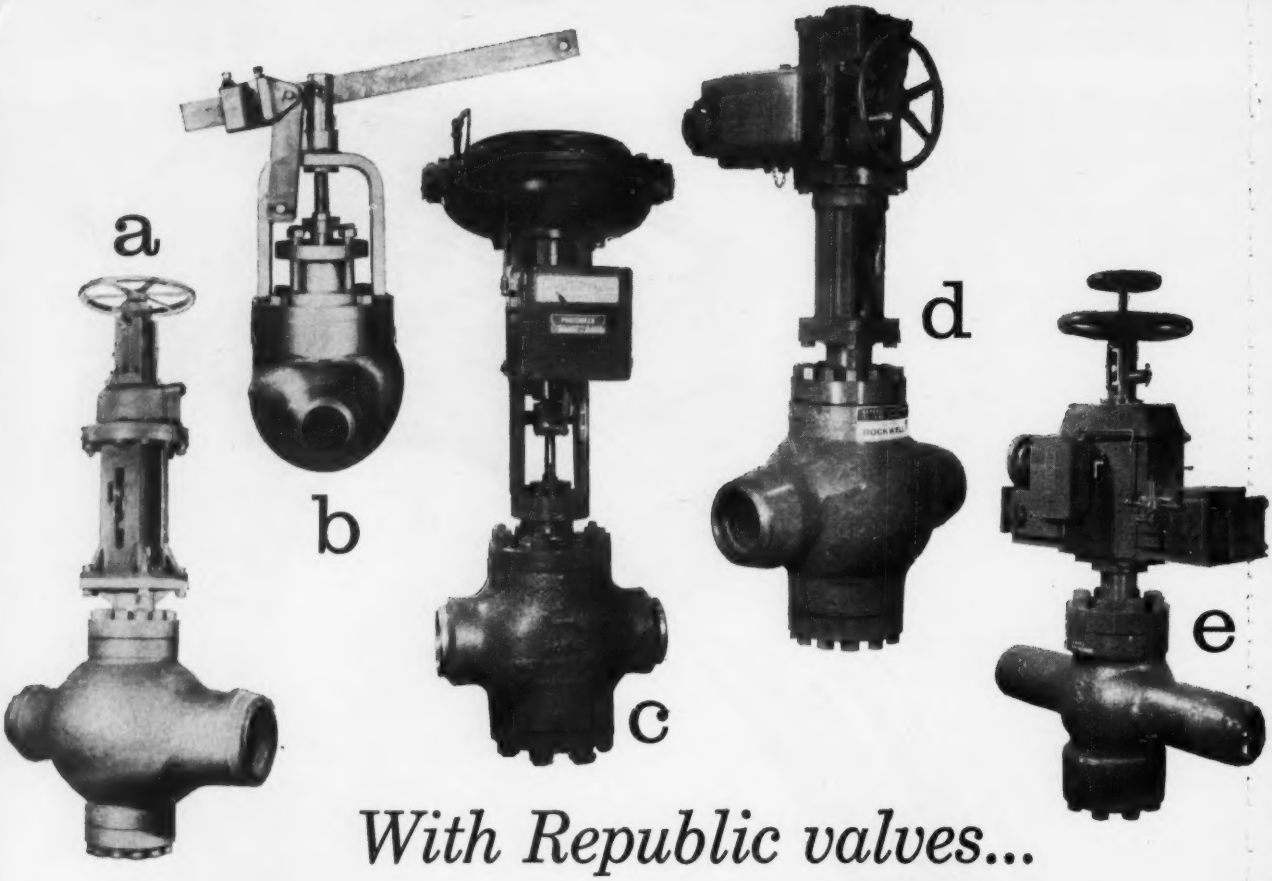
For predictable performance throughout all pressure/temperature ratings, look for Flexitallic Blue, the blue dye in the Canadian asbestos filler. It identifies the original Spiral-Wound Gasket construction.

FLEXITALLIC GASKET CO.
8th & Bailey Sts. Camden 2, N.J.

Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Flexitallic is a registered tradename. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue*—it's our exclusive blue-dyed Canadian asbestoes filler.



With Republic valves...

You get longer life, less maintenance

For over 35 years Republic valve developments have paced the changing demands for more sturdy valves by the most progressive utilities and industries. For such services as pump recirculation control, feedwater regulation, steam pressure reducing and high pressure water control, Republic valves have established a reputation for durability, long life and trouble-free performance.

Superior valve design—Republic research into the causes of valve noise and vibration, and also the wear resisting and galling properties of materials has resulted in a modern line of Republic valves of advanced design. Republic valve contours are designed to produce not only the desired regulating characteristics but also to reduce erosion damage and noise as well. Extra large guide bushings, extra deep stuffing boxes, solid plug inner valve construction, plus precise manufacture and long-life materials make Republic regulating valves perform better, last longer, with less maintenance.

Wide selection of valves and features—Rockwell-built Republic regulating valves shown on this page are representative of the complete Republic line:

a. **Cylinder operated valve**
b. **Lever operated valve**
c. **Diaphragm operated valve**
d. **Motor operated valve**
e. **Toggle head operated valve**
f. **Diaphragm operated angle valve**

And, for many special applications, such Republic accessories as pneumatic and electric valve positioners for hysteresis-free control, and a complete line of controllers are available.

Whatever your regulating valve problem, let Republic engineers put their years of application experience to work for you. For additional information, see your Republic representative, or write to Republic Flow Meters Company, 2240 Diversey Parkway, Chicago 47, Illinois.

REPUBLIC INSTRUMENTS AND CONTROLS
more fine products by
ROCKWELL

For more facts circle 824 on Reader Service card, p 227

COMPRESSOR QUIZ

Take this 5 minute quiz and check your knowledge of balanced opposed compressors.... ANSWERS ON NEXT PAGE. NO PEEKING!

1. What is the reason for an outboard bearing supported motor?

- ☐ Accessibility
- ☐ Shaft alignment
- ☐ Weight saving

2. Which design provides the smallest force couples?

- ☐ Bearing between the crank throws
- ☐ No bearing between the crank throws
- ☐ Both are equal

3. Structurally, what's the critical point in the multi-crank horizontal compressor from a design viewpoint?

- ☐ Lateral forces in the frame
- ☐ Vertical forces in the frame
- ☐ Cylinders

4. What type of motor is usually used on a balanced opposed compressor?

- ☐ Induction
- ☐ Engine-type synchronous
- ☐ Wound rotor

5. Can machine-mounted coolers and inter-stage piping be factory pre-fitted?

- ☐ Yes
- ☐ No
- ☐ Only on simple arrangements

6. Why is the balanced opposed compressor easier to install than other types of equivalent size?

- ☐ Lighter weight
- ☐ Less parts
- ☐ Semi-packaged design

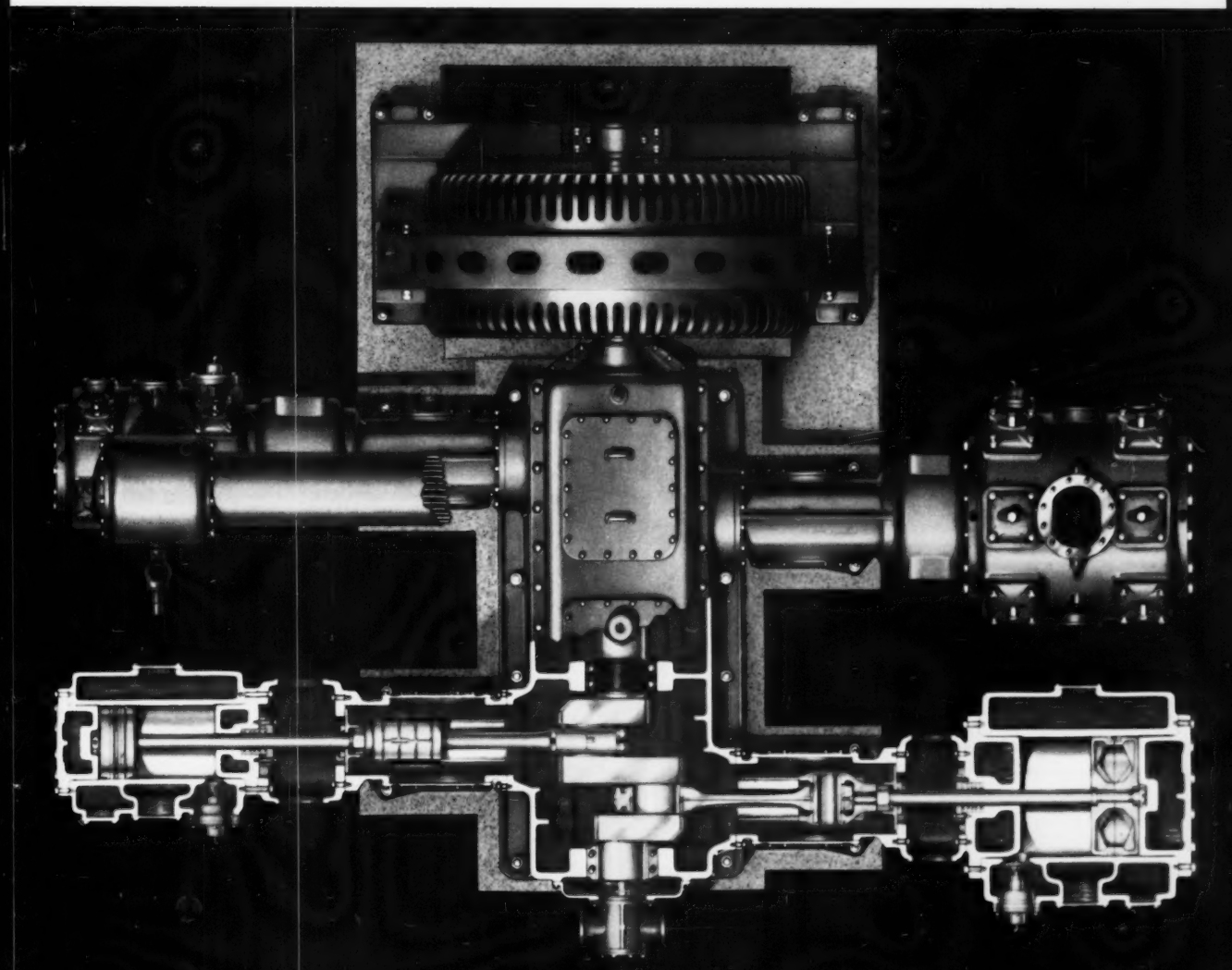
7. Is it common practice to install more than one compressor service on a single multi-cylinder frame?

- ☐ Yes
- ☐ No

8. Industry's most preferred compressor valve is standard with Worthington. It is:

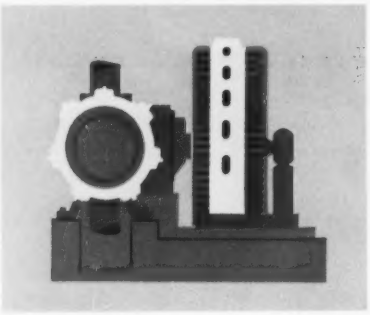
- ☐ A plate valve
- ☐ A spring activated valve
- ☐ A Feather Valve

WORTHINGTON



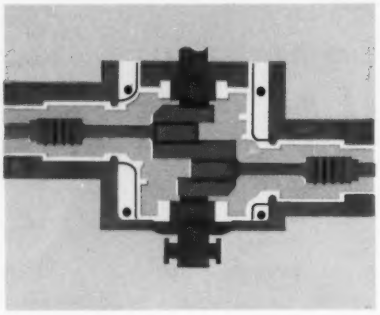
ANSWERS

to key compressor questions on previous page



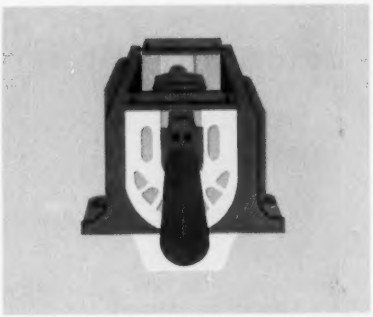
1. What is the reason for an outboard bearing supported motor?

Ans: Shaft alignment. Secure and permanent support of the large synchronous motor rotor is best obtained by placing a bearing on each side of the rotor.



2. Which design provides the smallest force couples?

Ans: No bearing between the throws. Worthington's adjacent crank design reduces couple arm to a minimum.

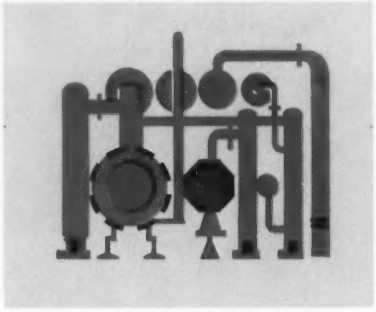


3. Structurally, what's the critical point in the multi-crank horizontal compressor from a design viewpoint?

Ans: Lateral forces in the frame which tend to distort the frame. Worthington's precision machined and fitted tie bars give solid support to the frame, preventing misalignment due to distortion.

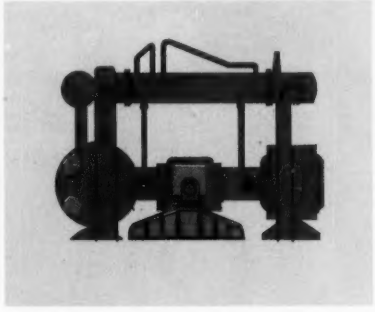
4. What type of motor is usually used on a balanced opposed compressor?

Ans: Engine-type synchronous is the major application; but complete flexibility of Worthington design permits use of any type driver, including turbine and gear or power engine.



5. Can machine mounted coolers and interstage piping be factory pre-fitted?

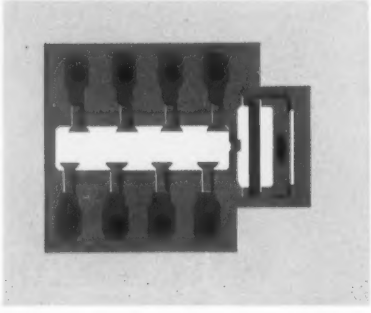
Ans: Yes. In fact, when overhead mounted piping and coolers are furnished by Worthington, such piping and coolers are always completely assembled and fitted to the compressor before it leaves the factory.



6. Why is the balanced opposed compressor easier to install than other types of equivalent size?

Ans: Semi-packaged design. Self aligning features permit easy and sure crankshaft, frame, and motor alignment on simplified foundation. Pre-fitted coolers and piping eliminate many problems associated with multi-stage compressor installation.

SCORING: If you got 7 or 8 questions right you're up-to-date on balanced opposed compressors and you recognize the value of the Worthington machine. If you got 5 or 6 right you're acquainted with some of the benefits of Worthington equipment, but you need brushing up. If you got less than 5 right, get in touch with your nearest Worthington technical representative. He'll give you the full story on the many advantages of the Worthington design. Worthington Corporation, Harrison, N. J. In Canada: Worthington (Canada) Ltd., Brantford, Ont. 36.5



7. Is it common practice to install more than one compressor service on a single multi-cylinder frame?

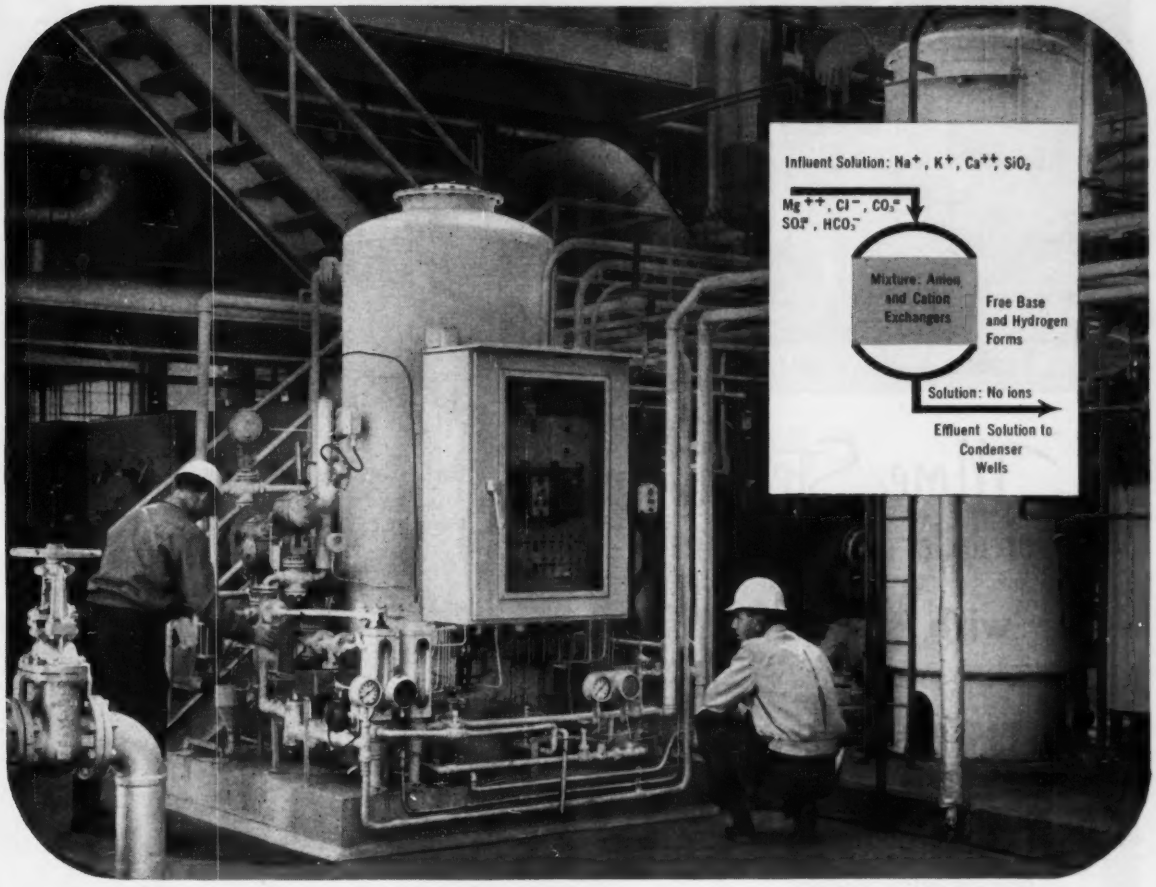
Ans: Yes. Particularly where the compression services are related, as in chemical plants. The arrangement results in substantial savings in initial plant cost.

8. Industry's most preferred compressor valve is standard with Worthington. It is:

Ans: Feather Valve! By actual count of 2 to 1, this outstanding compressor valve is preferred by operators and engineers.

WORTHINGTON

ION EXCHANGE RESINS protect ultra-modern power plant


Influent Solution: Na^+, K^+, Ca^{++}, SiO_2
Mg^{++}, Cl^-, $CO_3^=$
$SO_4^=$, HCO_3^-
Mixture: Anion and Cation Exchangers
Free Base and Hydrogen Forms
Solution: No ions
Effluent Solution to Condenser Wells

Low 0.001 ppm Silica Content of AMBERLITE-Treated Water Keeps Powerplant Turbines Clean as New for Five Full Years

A continuous supply of water with a silica content of 0.001 ppm and below has practically eliminated causes of maintenance downtime on boiler and turbines at Louisiana Power & Light Company, Ninemile Point steam electric generating station near Westwego, Louisiana.

When a turbine was opened for the first time in five years of operation, all blading was completely clean. There were no signs whatever of deposits. No boiler or superheater tubes have been lost and iron oxide deposits on tubes are described as "very low".

Using a MONOBED mixed bed of AMBERLITE IR-120 cation exchange resin and AMBERLITE IRA-401 anion exchange resin, LP&L supplies water with less than 0.1 ppm total solids content to generating equipment at its ultra-modern Ninemile Point Steam Electric Station. The unit is rated at 14,600 gallons with an influent of 380-mmho and effluent quality averaging 0.4 mmho.

LP&L reports results are better than an evaporator would give with the same water supply. The pH runs approximately 6.8 to 7.0.

Regeneration of the MONOBED unit is completely automatic. A master timer regulates the process. Control is much closer than would be possible under manual operation, resulting in substantial saving of chemicals and water.

In any ion exchange system, effluent quality is dependent upon not only influent composition but upon unit design and operating technique. Consult your engineering company experienced in water treatment for full information on how AMBERLITE ion exchange resins may help to solve your needs for deionized, softened, dealkalized or deacidified water. Write for your copy of our booklet "If You Use Water".

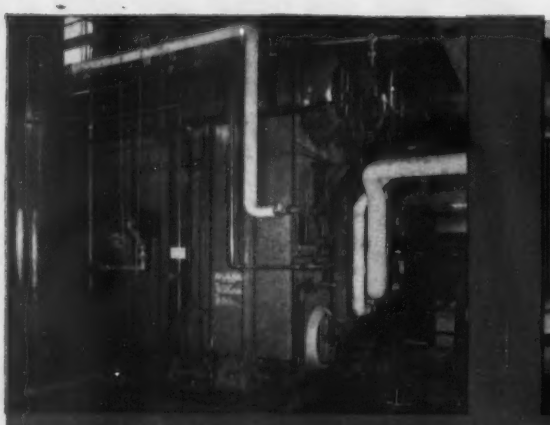
AMBERLITE and MONOBED are trademarks, Reg. U.S. Pat. Off. and in principal foreign countries.

Chemicals for Industry

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.



A 15,000 lbs/hr unit in a backwood plant

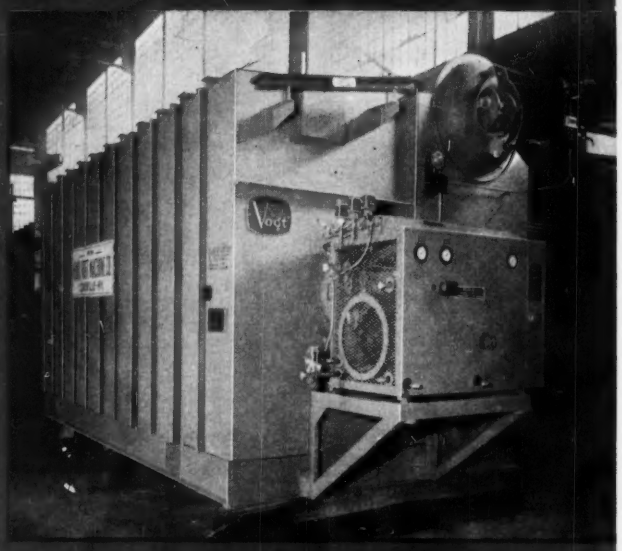
Boilers in various stages of completion in our shop

More Steam per dollar of investment with Vogt

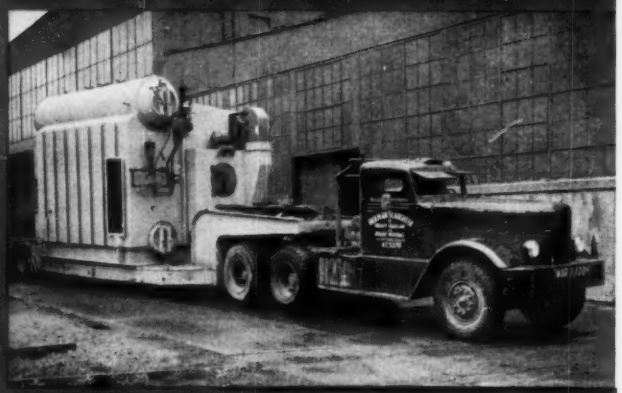
PACKAGE WATER TUBE BOILERS

Completely shop fabricated, with burners, controls and accessories installed before shipment.

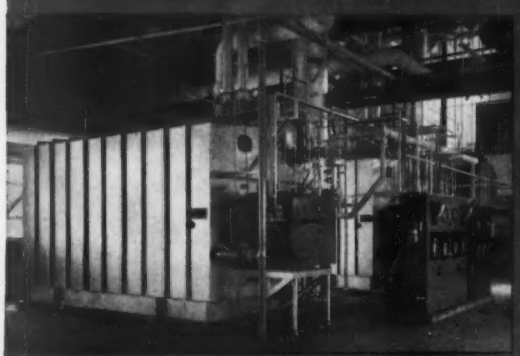
Placed on a suitable foundation, only fuel, water, breeching and steam connections need to be made to place unit in operation. Vogt Package boilers are available in oil and/or gas fired types in standard pressures of 175, 250 and 375 pounds per square inch gage.



One of two 30,000 lbs/hr units for a hospital



This 18,000 lbs/hr unit is one of two for an office building



Two 25,000 lbs/hr units installed in a manufacturing plant

Write for literature Address Dept. 24A-BP

HENRY VOGT MACHINE CO.
LOUISVILLE, KENTUCKY

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Camden, N. J., St. Louis, Charleston, W. Va., Cincinnati

LOUIS N ROWLEY, EDITOR • OCTOBER 1959 • ESTABLISHED 1882 **Power**

Plant design: 1959

One year ago, on this page, we forecast conditions favorable for the renewed growth of the American economy, and for those individual companies *prepared* to grasp the opportunities ahead. We stressed the word "prepared" because a comprehensive study revealed that a shocking proportion of industry's plant and equipment wasn't modern and efficient enough to insure profitable growth under increasingly competitive conditions.

Now, in October 1959, the American economy is moving upward at an even faster pace than forecast, and the years ahead are increasingly referred to as the "Sensational Sixties." Furthermore, during 1959 industry will spend more money on modernization of plants than ever before.

But we're not doing enough. At the rate of modernization projected for the four years 1959-'62, roughly 70% of the obsolete facilities on hand at the beginning of 1959 will be replaced. But when we allow for additional obsolescence that will occur during these next four years, it's clear we're doing not much more than half a job.

If anything, the need for action is more urgent than it was a year ago. Then the opportunities were mostly anticipated. Now, at an accelerating pace, they are becoming tangible and challenging. Now there is a frighteningly real possibility that individual companies failing to meet these challenges will lose their opportunity to participate profitably in future growth.

Our several responsibilities in this matter seem clear. Without modern and efficient power services no company can grow and prosper. It is up to the engineers who design and manage these facilities to measure their capacity and performance against the best standards of today and the even greater demands of tomorrow—and to "sell" top management the utter urgency of doing something *now* about any shortcomings that exist.

It is up to us as editors to provide timely and practical help for this important task. This second annual *Plant Design Issue* has been produced to do just that—at every stage of the job. Design surveys of new and modernized installations yield a wealth of detail on what other plant designers are doing. To familiar surveys of steam plants we add this year a brand-new one on air conditioning, and a second edition of the pioneering survey on in-plant electrical systems.

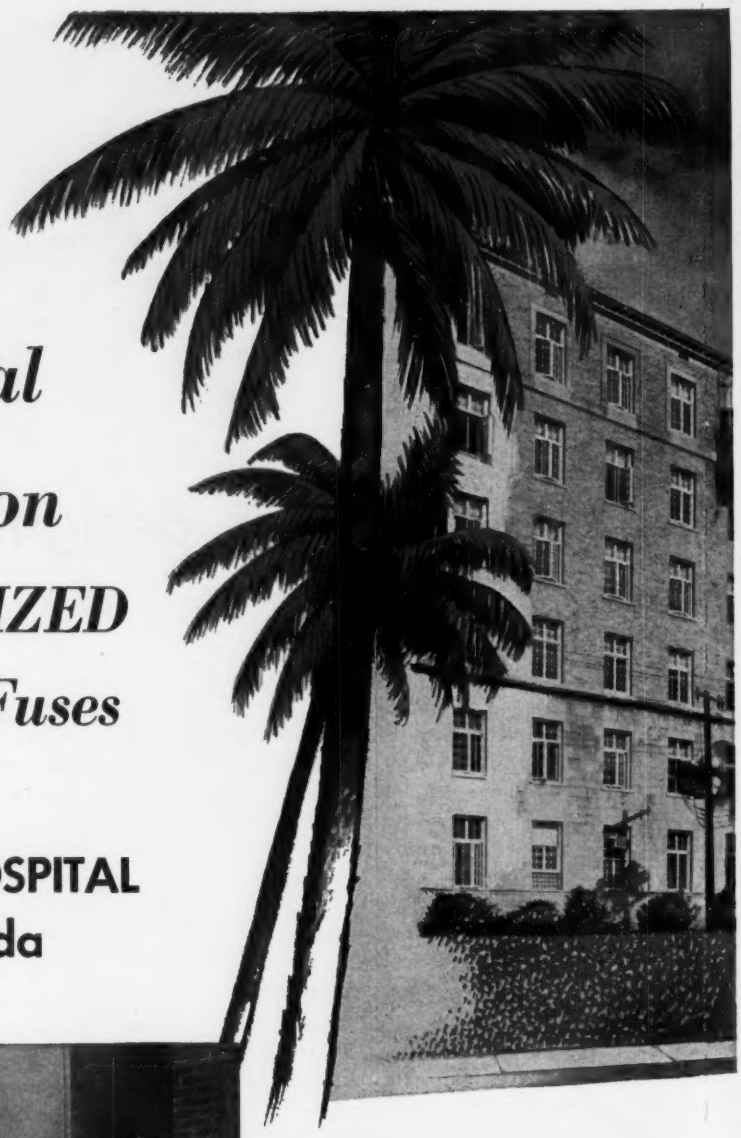
A series of staff reports highlights current trends in power-service design and probes the future to give you a basis for planning facilities that will be modern and efficient for years to come. And a complete roundup of the past year's new products and design aids gives you hundreds of sources for the additional data you will need when you come to grips with your own modernization program, whether it be large or small.

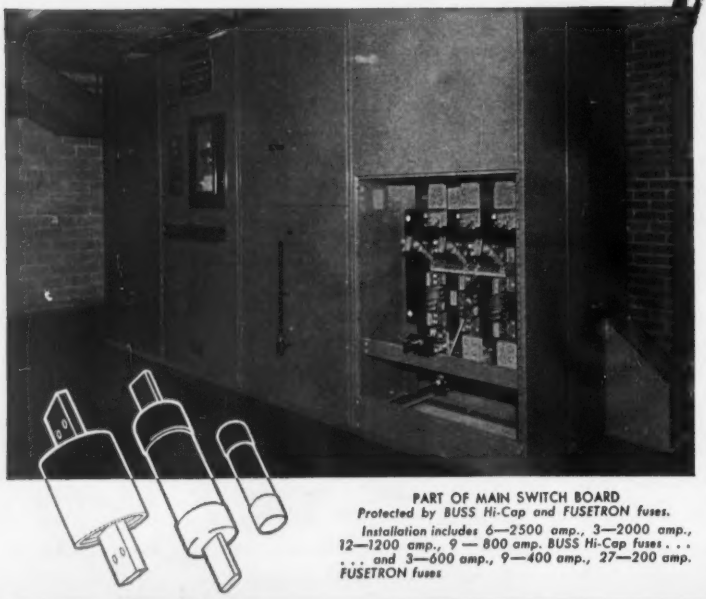
Use this issue to discharge today's most pressing responsibility — to guarantee your company the power-service base from which to grow profitably in the "Sensational Sixties."

Electrical Protection is MODERNIZED with BUSS Fuses

in the

TAMPA CITY HOSPITAL
Tampa, Florida





PART OF MAIN SWITCH BOARD
Protected by BUSS Hi-Cap and FUSETRON fuses.
Installation includes 6—2500 amp., 3—2000 amp., 12—1200 amp., 9 — 800 amp. BUSS Hi-Cap fuses . . . . . and 3—600 amp., 9—400 amp., 27—200 amp. FUSETRON fuses

In this beautiful hospital, tremendous in size, it was found necessary to increase the capacity of the electrical system to meet today's requirements. Modernization of the electrical system resulted in estimated available fault currents of 150,000 amperes.

With faults of this magnitude possible, it became essential that a superior type of protective device be used.

So in the main switch board are BUSS Hi-Cap fuses and FUSETRON dual-element fuses, both applied to give the interrupting capacity and dependability needed on the circuits they protect.

ANOTHER BUSS HI-CAP AND FUSETRON FUSE INSTALLATION

ARCHITECTS AND ENGINEERS: *Norman F. Six and Elliot C. Fletcher, Tampa and Schmidt, Garden and Erikson, Chicago*

CONTRACTOR: *Miller Electric Co., Jacksonville, Fla.*

WHY HIGH INTERRUPTING CAPACITY IS NEEDED

Fault currents of 75,000 or 150,000 amperes were unheard of a few years ago, — but today they are quite possible. With the generating capacity of utilities increasing yearly, most likely the magnitude of fault currents will be higher in future years.

BUSS Hi-Cap and FUSETRON dual-element fuses have an interrupting capacity designed for today's conditions and to anticipate system growth.

The interrupting rating of BUSS Hi-Cap fuses is 200,000 amperes rms symmetrical — and for FUSETRON fuses it is 100,000 rms symmetrical.

WHY DEPENDABILITY IS NEEDED

With higher fault currents available, the dependability of the protective device becomes of increasing importance.

The protective device should be just as accurate in 10, 15, or 20 years, as it is on the day installed.

A fuse is the only type of protective device to offer this advantage. A fuse must remain safe and accurate, as its operation depends on a simple thermal law. A fuse has no triggers, latches, pivots or contacts to stick or get out of order. Dust, fumes, corrosion or age cannot increase a fuse's capacity or lengthen its blowing time.

for more information

On FUSETRON dual-element fuses - (loads of 0 to 600 amps.) - *write for bulletin FIS*

On BUSS Hi-Cap fuses - (loads above 600 amps.) - *write for Bulletin HCS*

959

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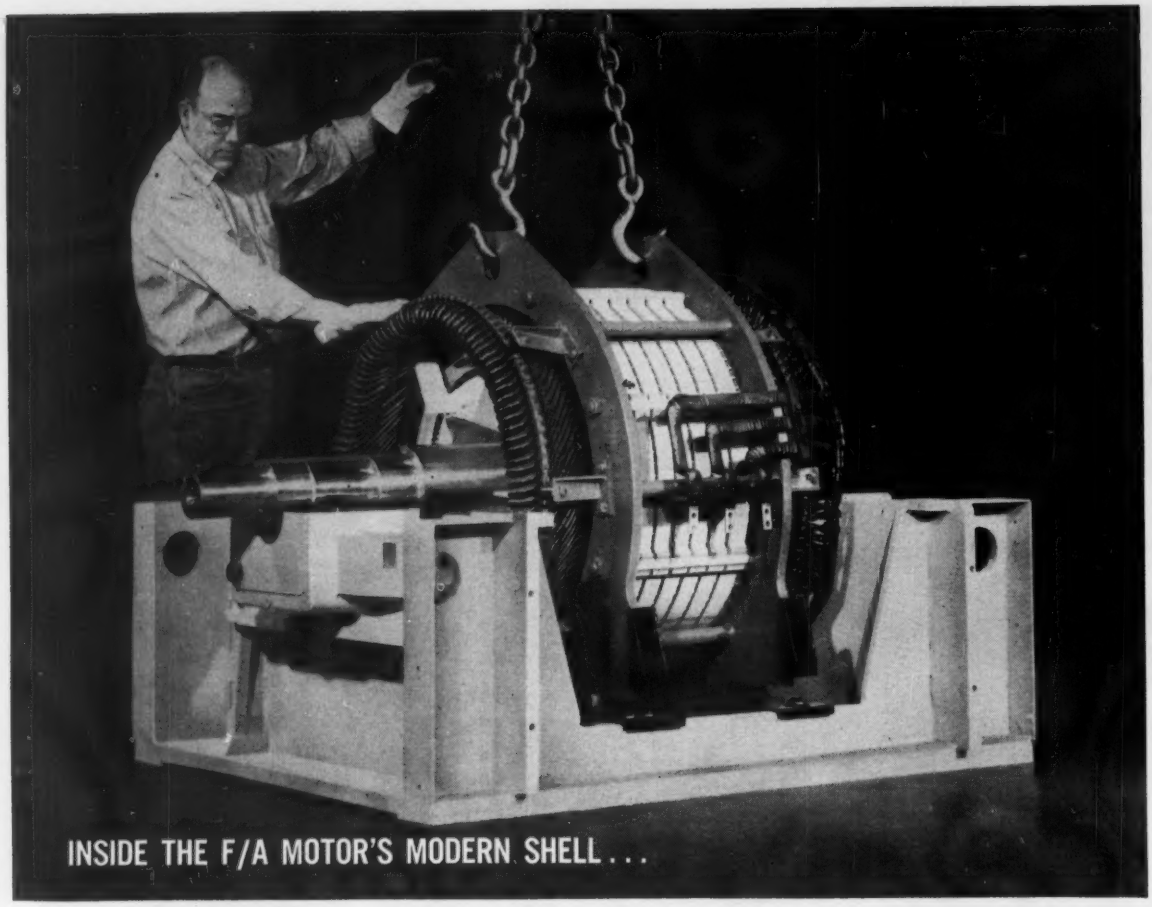
For more facts circle 828 on Reader Service card, p 227



INSIDE THE F/A MOTOR'S MODERN SHELL . . .

long life, lowest maintenance, backed by 7000 success stories

WEATHER-TESTED FOR OVER TWO YEARS...WITH NO MAINTENANCE!

This conventional indoor, 600-hp motor with Thermalastic insulation has been running outdoors for more than two years. Built before the F/A Motor was introduced, it has been subjected to these rigorous conditions:

- Twenty-four hours a day, five days a week, with weekend shutdowns to produce stopping and starting surges
- Summer and winter, all weather and temperature extremes
- Two-week shutdown during which it was sprayed almost continuously with fire hoses

It is still running smoothly and shows no signs of insulation breakdown or other deterioration.

In 7000 large-motor installations and over 15 million horsepower of Westinghouse large rotating apparatus, not a single breakdown occurred from Thermalastic® insulation failure.

One reason for this amazing service record lies in the unique molecular structure of Thermalastic insulation. Large, overlapping mica splittings are locked in a void-free, memory-type elastic bond, forming a perfect dielectric barrier which is maintained under *all* operating conditions.

Because of Thermalastic, your F/A Motor serves you longer and better. This insulation system withstands prolonged voltages, abrasion, corona arcing and frequent-starting surges. F/A Motor applications are virtually unlimited because Thermalastic is chemically stable, will not react, dissolve, crystallize or evaporate in contact with acids, alkalis, oils, lamp black, dirt, moisture or temperature extremes.

Consider what these proved performance extras can mean in down time and maintenance savings alone. For more specific test data, call your Westinghouse representative, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. J-15013

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Power reports on...

Industrial Plant Design

Continuing changes in power-services economics and industrial requirements affect design of tomorrow's plants. *Power* calls attention to important areas of development in the following series of reports

Generation of economical in-plant steam and electrical power depends on the power man's careful balance of equipment first cost and operating cost. In this roundup we spotlight cost-saving design techniques and areas of change **p 80**

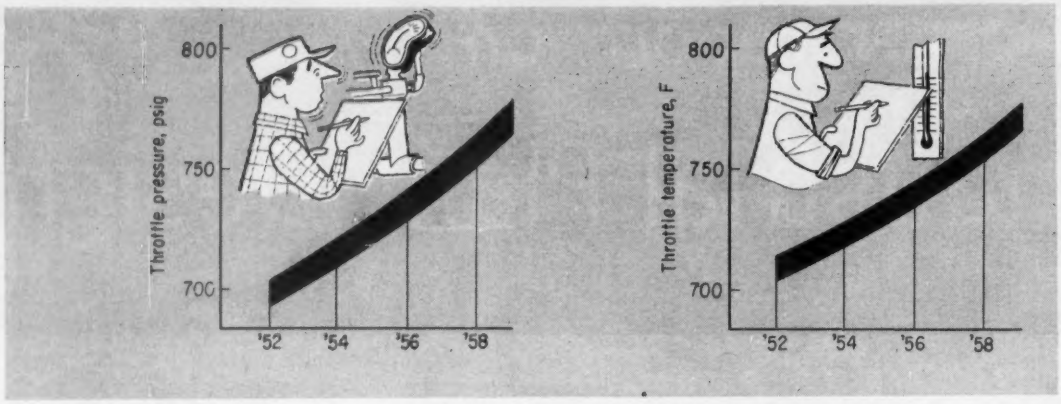
Comfort cooling of industrial plants promises to be a major concern of power engineers. Here we report reasons why you will want comfort cooling, and outline current trends in equipment and system design for future or existing plants **p 87**

Main substations must provide reliable electric service and power-to-grow for tomorrow's expanding loads. This report represents a summary of top thinking on best practice in circuitry, grounding, equipment, standardization **p 92**

Plus trend-setting highlights of other important services

Generation

Although overall economics of electric



STEAM CONDITIONS ARE RISING as economic in-plant generation forces higher turbine throttle temperature and pressure

New ways to make in-plant generation pay

- Absorption refrigeration supplies summer load for turbine
- Better utilization of waste heat and fuel cut operating cost
- New equipment packaging trims first cost

Growth of in-plant electrical-power generation continues, but at a slower rate than in past years. At the same time, utilities increasingly supply electric-power loads in plants which previously would have generated at least part of their own power requirements.

Why is this so? Because of utilities' increasing readiness to cooperate with industry in supplying large power blocks for special purposes, and the high overall dependability of power supply from utility networks and power pools.

Today, inclusion of in-plant power generation depends almost entirely on economic justification rather than dependability or availability. Power costs vary across the country, from cheap-hydro areas to utility systems with all thermal plants and high fuel costs which boost consumer rates.

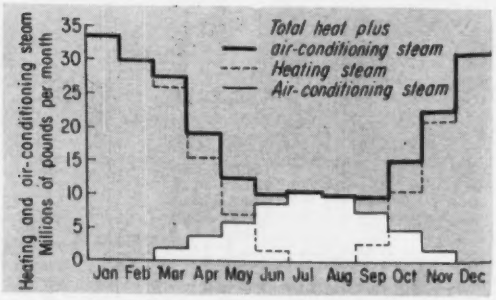
In-plant power usually is generated as a result of special process-steam needs which can be supplied by extraction bleeds from a power turbine. There is nothing new in that statement. But trends bring to light several new facets of the situation.

POWER's *1959 Plant Design Survey* indicates a continuing increase in turbine-generator unit capacity and higher throttle temperatures and pressures. Bar charts, above, show this trend for the past ten years. Trend can be credited to two major factors. (1) Greater ratio of electrical demand compared to steam demand pushes throttle steam conditions and unit capacity higher. (2) A snowballing economic-design problem results from demand for higher steam conditions for process use.

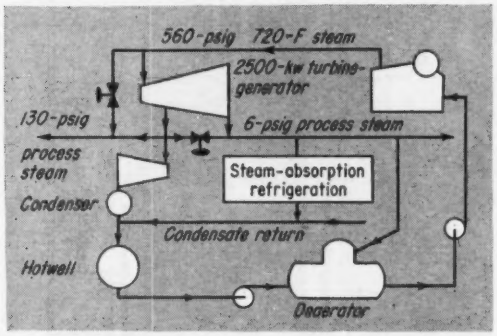
Process steam is usually supplied by one or more extraction points. For a specific extraction-steam condition there is a minimum economic throttle-steam condition. And as throttle conditions rise, minimum economic turbine capacity goes up. Also, fuel, labor and material costs continue upward, forcing design engineers to plan larger individual units to keep power-generation costs down. Overall effect of these factors is a gradual tightening of conditions under which in-plant gen-

Effect of rising fuel

generation usually hinges on process steam load...



STEAM-FLOW LOG for one year shows absorption refrigeration's effect in removing summer valley from steam load



PLANT CYCLE supplies basis for economic in-plant power generation by year-round utilization of turbine exhaust

eration can be justified, and a consequent search for new techniques which will counterbalance rising costs for operation and construction.

For plants that need to generate their own power, the current problems involve finding cheaper ways to produce power, minimizing capital outlays where return is slow, simplifying operation and maintenance and investigating new thermal cycles.

Equipment manufacturers, consulting engineers and plant power engineers have joined forces to attack their common problem from three directions: (1) Investigate and develop more efficient sources of year-round byproduct power. (2) Make complete use of waste energy as a power source. (3) Make the best use of modern prefabrication techniques and design standardization to cut capital costs for previously tailor-made equipment.

In this issue, POWER reports on trends resulting from this three-pronged attack and spotlights some specific applications.

Byproduct-power generation often includes the classic combination of high-pressure process steam with low-pressure steam (20 to 5 psig) for additional process load or plant heating. High-pressure steam requirements are supplied by turbine bleeds and low-pressure steam by exhaust from noncondensing units. For those plants where low-pressure steam supplies plant heating system, by-product-power use is obviously curtailed in summer months by the lack of exhaust-steam demand.

Depending on the electrical and process-steam load balance of the plant, in-plant generation might seem a poor bet for a new installation. How can such a plant produce cheap power? The answer lies in a search of power services for possible use of the idle steam. In some plants this search leads to absorption air-conditioning equipment as the outlet for low-pressure steam. Results for one plant are illustrated, left. For the complete story of how important this power service may be to your future see our report on comfort cooling, p 87.

Parke, Davis & Co engineers found big savings in byproduct power. This available power became the deciding factor when they installed air conditioning in their Detroit plant. Existing turbine-generator operated in parallel with utility lines, which were primarily for standby and purchased power. Although rated at 2500 kw, the single noncondensing unit was limited to 2000 kw during summer months when exhaust steam couldn't be used for plant heating. At full load turbine output represented about 75 to 80% of plant electric demand and an annual saving running to approximately $180,000. Under these circumstances, absorption refrigeration equipment was the only economic choice for plant air conditioning.

A total of 1600 tons of refrigeration has entered service to date, all operating from turbine exhaust steam. Plant cycle, left, shows steam-operated absorption refrigeration as only available heat sink during summer months. Steam-flow log, above left, indicates results for a typical 12-month period. Byproduct power resulting from full-output summer generation saved an additional $26,000 per year. At the same time, use of exhaust steam for refrigeration source improved plant steam-load balance and kept electrical requirements within limits of existing utility lines and primary switchgear.

Addition of 575 tons this year is expected to increase savings, but at a decreasing rate. For the complete story, watch POWER's November issue.

Parke, Davis is currently building a new research center at Ann Arbor, Mich., incorporating three 700-ton absorption machines for comfort and process cooling. Here, too, self-generation of power is expected to tie in with absorption cycle for maximum economy of overall plant services.

continued

costs may often be cancelled out by the system designer

One answer to rising operating costs

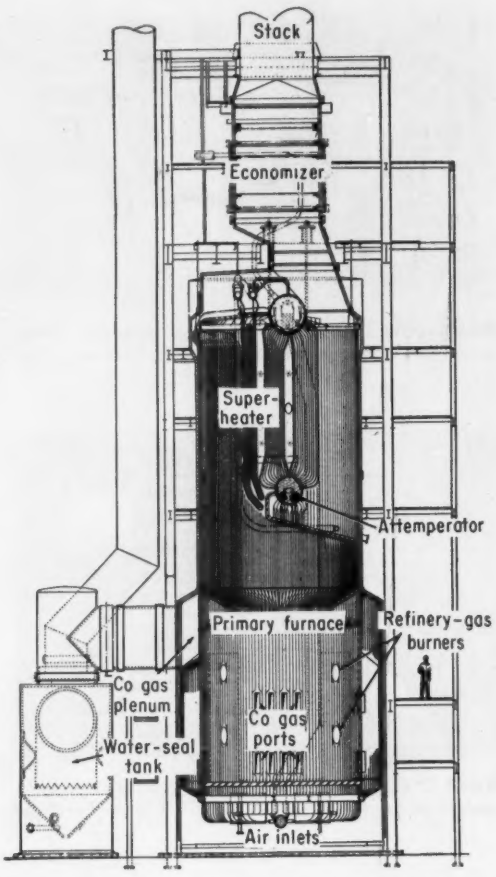
In many industrial plants a second area for possible cost savings exists. In contrast to the more efficient utilization of steam energy to assume part of operating costs, investigate the utilization of waste energy to reduce direct fuel costs. In many situations disposal of waste heat or waste fuel represents a vexing problem so use can produce double savings.

Waste-heat or waste-fuels use can cut operating costs radically. But the sizable savings possible are often tempered by higher first cost of special equipment and increased difficulty of operation. Equipment manufacturers have concentrated much of their effort in developing new burning equipment and firing techniques. The result has been cheaper, easier firing of several waste gases and solid fuels such as bark, wood waste, coffee grounds etc. At the same time new designs in waste-heat units cut first cost and minimize maintenance.

Bark-burning units in pulp mills are rapidly increasing in number. But this is still a recent trend; many mills started up in the past three years do not burn bark and wood waste for power, although these same mills chase down each Btu in the chemical-recovery cycle.

Bark and wood chips containing up to 50% moisture are often fired on spreader stokers. However, one paper company installed cyclone-fired boilers for bark, coal, oil or gas burning. Bark and regular fuel are burned in varying proportions depending on analysis of fuels. Cyclone or stoker firing requires bark sizing and consistent, adequate feeding for stable ignition. In return for extra effort of fuel sizing and supply, operators get higher unit efficiency, especially during swinging loads typical of industrial plants. This is partially due to the ability to operate the new units automatically.

CO gas occupies a special position between a waste heat source and waste fuel. Gas is generated in the process of burning off cracking-unit catalyst. Gases leave regenerator at about 1000 F and contain from 5 to 8% CO with a trace of hydrocarbons. They are fed to special boilers with supplemental fuel where 100% of the heat of combustion and about 50% of the sensible heat is removed—supplemental fuel is required to maintain furnace temperatures of 1500 to 1800 F for ignition of the CO gas. Firing supplemental fuel boosts steaming rate above base supplied by CO. Units designed to operate at or near the rate of firing for stabilized combustion are minimum boilers. They pay off only where the principal objective is incineration of waste gas and plant requirements do not justify greater output. With this arrangement costs for investment and supplementary fuel will be at a minimum but your boiler lacks operating range.



CO BOILER handles waste gas in vertical-design unit. Refinery gas, oil firing sustain furnace at ignition level

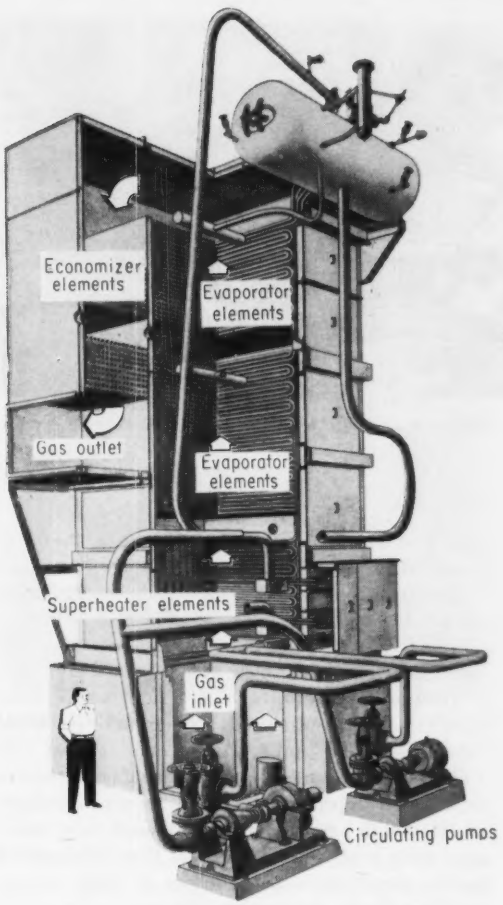
Use of supplemental fuel can be eliminated by passing CO gas through combustion-catalyst bed in the boiler furnace. This results in spontaneous combustion of CO at lower temperatures and with less operating flexibility than when firing supplementary fuel.

Special use of a CO boiler is usually restricted to direct connection to catalytic-cracker regenerator since waste-heat recovery is part of unit's economic justification. Fuel savings possible with one CO boiler range from $250,000 up to $750,000 per year, depending on the quantity of CO gas available and price of supplemental fuel.

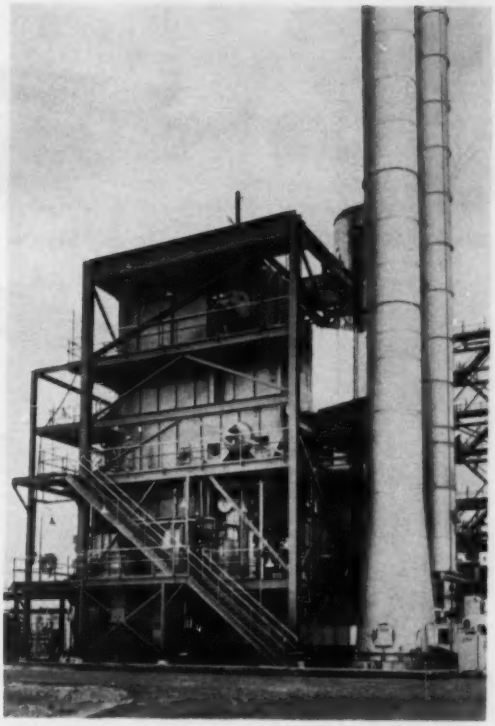
Boiler design for recent units falls in two categories. Unconventional but basically standardized

Fuel savings are only part

lies in efficient use of waste heat, waste fuel



WASTE-HEAT BOILER shipped as a package represents latest design of heat trap and primary solids collector



REFINERY BOILER burns CO in standard-design unit. Boilers of this type team with gas turbines in one plant

unit, above left, is typical of more than a dozen CO boilers recently installed. In addition to gas burners shown, units often include oil burners for steam generation during regenerator outages.

Conventional unit, far right, uses standard boiler design and multifuel burners. Boilers of this general type are teamed with gas-turbine-drive compressors at a Gulf Coast refinery. Forced-draft fan supplies combustion air when turbine exhaust is not available.

Waste heat as a source of power still finds its greatest application in basic-materials plants, such as metal-refining plants, cement mills, petroleum refineries, etc. Primary object is selection of heat source with high enough temperatures to be useful. This ranges from 800- to 1100-F gas from wet-process cement kilns, through 1100 to 2200 F for various steel-mill processes, to peak of 2500 F found with copper reverberatory furnaces' exhaust gases.

Along with sensible heat most of the waste-heat gases carry solid material. In many cases waste-heat boilers can act as primary collectors for solids carryover or as condensers for sublimed solids.

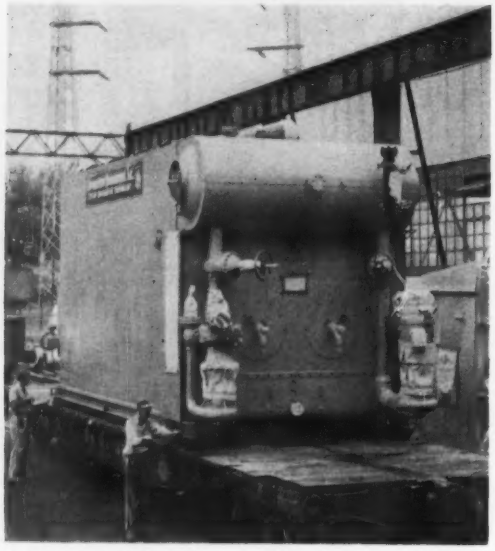
Recent developments in waste-heat units have aimed at easier cleaning of surfaces, erosion cutdown and generally reduced maintenance.

Tailor-made units, designed from the base up for one specific plant have been the rule. But now demand for waste-heat units has increased to the point where boiler manufacturers are starting to market shop-assembled, standardized designs. The trend toward standard designs and shop assembly

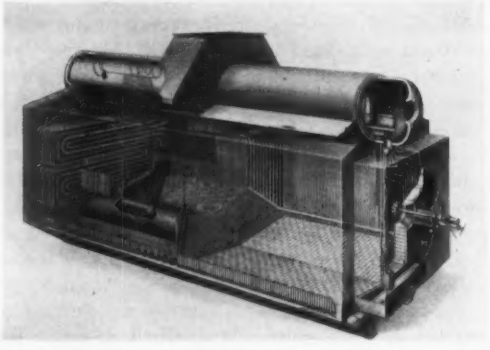
of the picture: look at equipment packaging for lower first cost

Packaging of large units introduces

GIANT PACKAGED BOILER lumbers through Manhattan on final leg of transit. Truck regulations may boost delivery expense



RAIL TRANSPORT dictates basic dimensions of package. Circulating pumps, twin burners mount within limits



NEW UNIT, shown in cutaway and on truck, has saddle-breeching set for easy connection to packaged air heater

cuts first cost enough to justify installations in plants which could not previously make them pay.

Packaged boiler, p 83, center, handles gases from open-hearth furnaces in several steel mills. Because of relatively small size, unit requires slightly more space than normal furnace outlet breeching.

Designers' attempts to cut cost of steam-generating equipment produced standardized packaged (shop-assembled) units. As savings in first cost and operation became apparent, manufacturers were called upon to produce packaged boilers for ratings of 100,000 lb per hr and up. Although these packaged units cost considerably less than field-erected boilers they pose some problems of their own in traveling to the power-plant site.

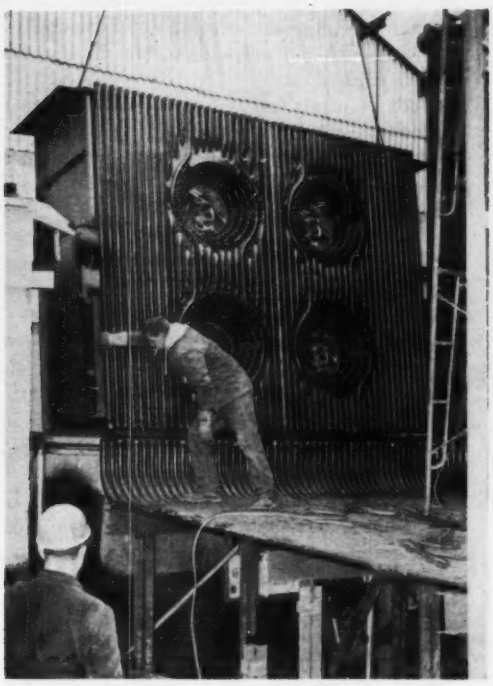
Transportation of these giants becomes an important design criterion. Boiler height and width are limited to railroad clearances. Flatcar length dictates maximum boiler length.

Within these fixed limits manufacturers designed a family of steam generators basically similar in their outside dimensions. Although basic design limits were set by rail clearances, purchasers of units like the behemoth above may find they must arrange for final delivery to the boiler room by truck—even when rail spur enters plant property, the last 100 yards to the boiler room may require transferring the packaged unit to a flat-bed truck.

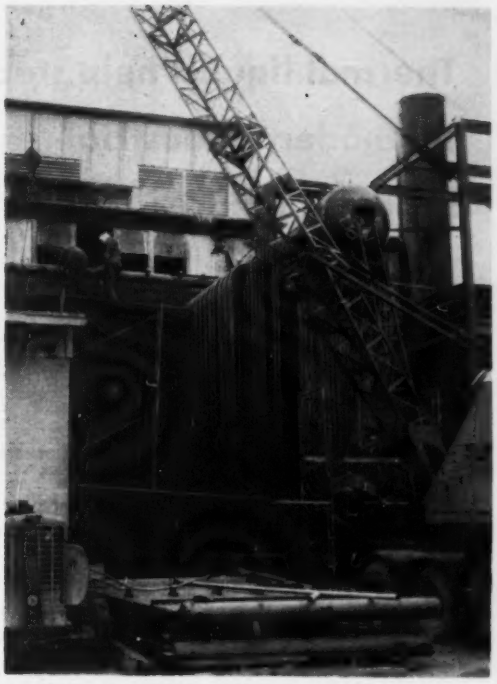
Size limitations for trucking vary with state and local regulations. In most cases oversize cargo is not prohibited but necessitates special licensing, insurance and penalty fees. Since trucking load regulations are so variable and flexible they do not affect package design. However, regulations do represent added expense for packaged units and should be considered in comparing pros and cons of various packaged and field-erected boilers.

To trim cost

one question: How far does it pay to go?



PREFABRICATED WALL, including burners, swings up for welding to floor section also installed as one unit



SEMIPACKAGED UNIT includes seven shop-assembled panels in furnace. Boiler bank is economical field-erection job

Cost savings from shop assembly of even-larger units are cancelled by handling problems. Stopped in their efforts to move larger packaged boilers, manufacturers looked into possibilities of prefabricating subassemblies. The basic question still remained: How far can you afford to go in prefabrication before handling costs cancel construction savings?

This question was not an easy one to answer since maximum savings depended on complete utilization of shop advantages. In one case this included use of a new method of constructing furnace-wall sections. In turn, standard boiler designs didn't make effective use of new wall construction. Final result was an entirely new unit designed to take full advantage of prefabrication and covering a capacity range of 80,000 to 450,000 lb per hr.

What does this mean to you? Approximately 25 to 35% reduction in erection costs. For a new plant or one with easy access savings may be greater. For existing plants, snaking prefabricated sections around existing structures may or may not be a problem. Variations in erection costs are mainly due to this one factor.

Erection simplicity shows up in photos, above. Prefabricated burner section, floor and roof panels join at field welds. Furnace side walls including headers, stub risers and supply tubes swing into place as two panels per wall. A total of seven sections forms the entire furnace.

Boiler generating-bank tubes are not shop-installed. Drums for these units are too long, generating banks too high to permit economical shipment as a prefabricated unit. At the same time, generator-bank tube rolling is fast and easy so no great saving is possible in this region. Furnace insulation and exterior casing are field-installed by modern methods which rival shop assembly in speed. This does away with special crating and handling to prevent crushing or scarring cased sections.

Packaged air heaters readily lend themselves to modular construction. Shipped as complete units, new air heaters require only bolting down and connection of oil, water and power where packaged lines and circuitry terminate.

For the time being packaging of large boilers appears to be limited to the modular construction outlined above. Further developments will await more changes in basic unit design, newer shop-fabrication techniques and demand for larger units.

of equipment further you can use thermal-liquid system...

Thermal liquids help step up modern industrial processing pace

As pointed up in POWER's report on thermal-liquid systems (August 1959, pp 53-58), new developments and increased production requirements in the chemical and process industries are demanding higher-temperature heating. Temperatures that these industries must have, to compete for markets of the future, are no longer practical with steam systems. The extreme pressures corresponding to high steam temperatures would mean equipment and controls of such costly nature as to price the end product out of the market.

Industrial plants needing extremely high process temperatures have for years used eutectic salts (such as mixtures of sodium nitrate and potassium nitrate) in unpressurized systems at temperatures up to about 1200 F. But these media have disadvantages: freezing points are high, around 300 F, and thermal equipment generally has to be stainless steel where operating temperature goes above 900 F. Also, eutectic-salt systems must have tracing facilities for heating and good drainage to handle the salt on shutdown.

Consequently, chemical and process industries are turning more and more to thermal liquids, heat carriers which supply up to 750 F at little or no pressure. Applicable in both vapor and liquid phase, these heat vehicles handle jobs varying from cooking potato chips to processing chemicals.

Majority of industrial plants have need for thermal liquids in the 400- to 750-F range. The 400-F mark is where departure from steam is usually made. Consultants, thermal-liquid-system equipment manufacturers and plant engineers contacted appear to agree almost unanimously on what constitutes good design and successful operation.

Experience has shown that regardless of liquid- or vapor-phase application it is poor policy, in many cases, to attempt to convert existing conventional boilers and heat exchangers from steam to thermal-liquid service. This is also true to a large degree of pumps, valves, piping and fittings.

Today's thermal-liquid system has a boiler or heater designed to be an integral part of the system. Ordinary firetube or watertube heaters which depend solely on convection give satisfactory performance only at relatively low temperatures with liquid-phase systems. Above 450 F such systems require a heater designed for forced circulation. Not only do these heaters cut down the possibility of localized "hot spots" which promote thermal breakdown of the liquid, but they permit heating the liquid close to its critical (decomposition) point. This allows liquid to carry its maximum heat-energy load to point of use.

Today's plants using liquid-phase systems have both firetube and watertube heaters designed specifically for the service. True, forced-circulation units require pumping-power input but they afford a large heat output within a limited space and particularly with low headroom.

Vapor-phase systems employ natural-circulation heaters but these units are specially designed to work with the heating medium at efficiencies which would be difficult to obtain using a converted steam boiler. Vapor-phase systems need pumps only when condensate can't return by gravity.

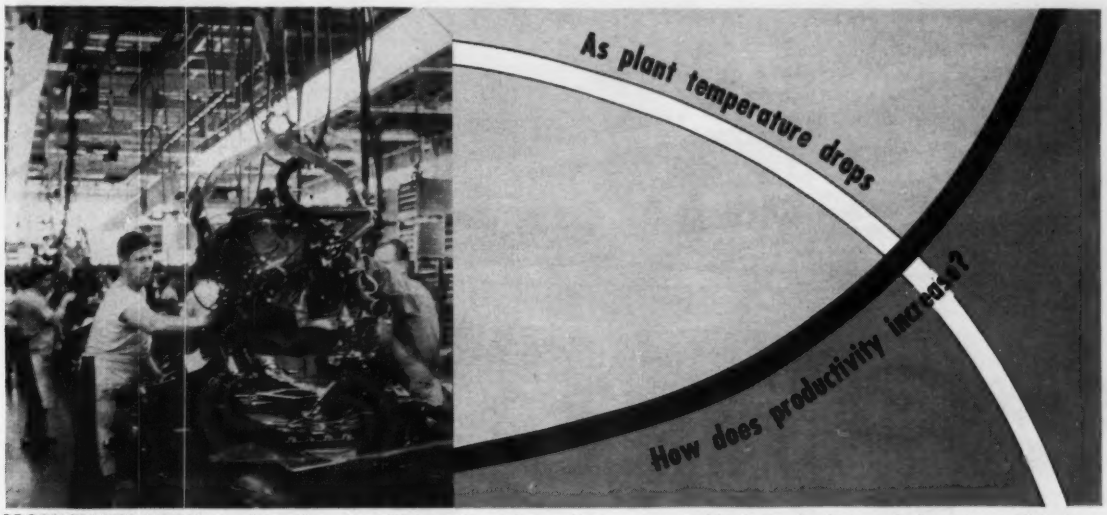
Typical of a plant's swing to new equipment rather than attempting to convert existing facilities is how Rubber Corp of America in Hicksville, L. I. met its need for higher process temperatures. Existing steam boilers supplied temperatures suitable for calendering operations, but not the pinpoint temperature control required. Plant engineering called in American Hydrotherm Corp. Together, they came up with a steam-generated high-temperature water system. With h-t water in the calender rolls, precise temperature control is easily obtained.

Subsequently the plant needed temperatures up to 550 F for batch processing of a plasticizer. Again with American Hydrotherm on the team as system designer, plant installed a thermal liquid (*Aroclor 1248*) split-range system for both heating and cooling a jacketed 2000-gal kettle. With installation of these new systems, American Rubber Corp achieved needed temperatures, and fine control of them, plus lower overall operational cost than would have been possible by revamping steam facilities.

A dramatic example of thermal-liquid system potential is the application being readied for Grumman Aircraft Engineering Corp's plant at Bethpage, L. I. Presently in advanced design stage, system will be completely installed within the next few months. (Watch for a full report on this installation in a future issue of POWER.)

In a new approach to airplane section fabrication Grumman plans a thermal-liquid system with complex heating and cooling circuits. Designed by American Hydrotherm Corp, system incorporates a 1-million Btu per hr capacity liquid heater and a sizable accumulator to serve a number of press platens, collectively or separately, with liquid at temperatures controlled to within ± 5 F.

Grumman's decision to employ this heat-transfer medium, after close economic scrutiny, is another indication of industry's trend toward installation of completely new facilities to meet needs for higher process temperatures. Here again, extensive and expensive changes in existing steam facilities were rejected in favor of the thermal-liquid scheme.



PRODUCTIVITY BOOST resulting from installation of comfort-cooling systems is big factor in design of plant air conditioning

Comfort cooling bids for role as major industrial power service

POWER's first air-conditioning survey indicates that only a small percentage of existing industrial-plant systems went in with comfort cooling as a primary aim. But a growing number of plant managements are becoming interested in comfort cooling of production areas. This interest results from reports of increased productivity, reduced absenteeism and labor turnover for plants with comfort-cooled manufacturing areas.

Initially, factory air conditioning went in to improve a product or process. Savings resulted which were obviously tied to comfort cooling. Plant engineers saw that worker efficiency went up in air-conditioned areas, but had no way of accurately measuring the degree of increase. Without a yardstick for performance, justifying factory comfort cooling to management was a tough problem. The only actual data came from a January, 1959 government report.

Government research came up with facts and figures which clinched the argument as far as federal office buildings were concerned. General Services Administration research personnel ran tests in two sections of an office building where duplicate repetitive work occurred. One section was air conditioned, the other not, and production records for the two sections were carefully checked for a period of five months.

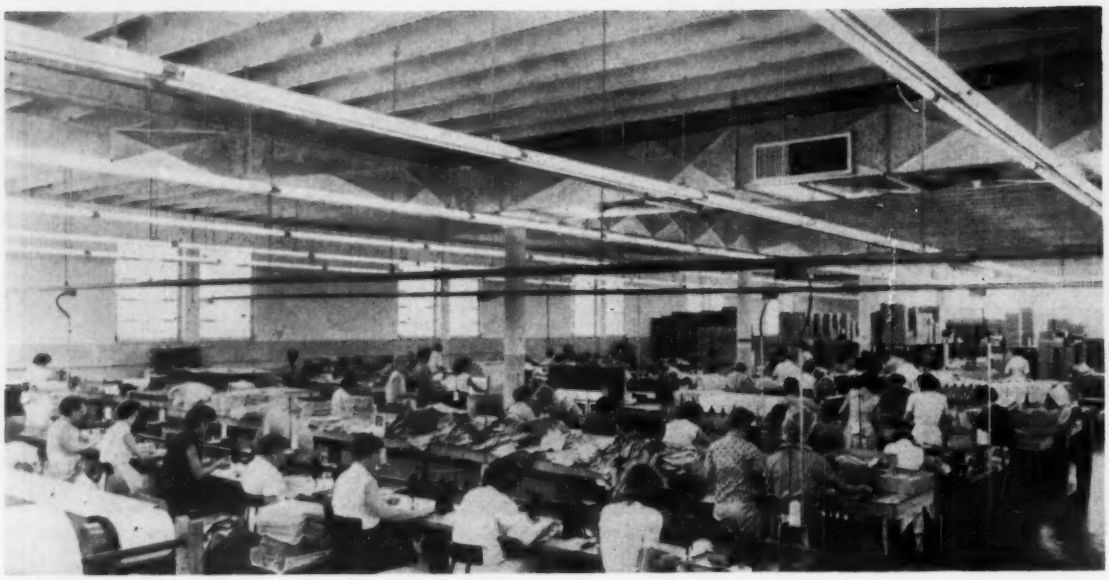
Did air conditioning increase work production? The answer was an emphatic "yes." On the basis of the tests research personnel concluded air conditioning resulted in 9.5% average increase in work production, a slight decrease in errors, 2.5% decrease in absenteeism.

Less tangible effects filled in the picture. Consumption of chilled drinking water dropped considerably. In office buildings with over 10,000 workers a small saving in drinking water per person may add up to a big saving in installation and operating costs. What fewer trips to the water fountain mean in terms of increased production is still another story. All employees, male and female, reported a saving in cleaning bills and the women noticed a saving in makeup and hairdo expenses. In general, workers in cooled areas felt less fatigue, showed higher morale.

Although these tests were run in an office building, results should hold equally well for factory production jobs. Depending on the type of production work, plant location and environment, productivity increases ranged from 10 to as much as 150% after comfort cooling.

It is all well and good to talk of increased productivity, but what does it cost to install comfort cooling and how do you establish payout rates for equipment? A recent and unique study by a group at Minneapolis-Honeywell Regulator Co tackled the problem of estimating efficiency increase needed to pay the cost of owning and operating an air-conditioning system. Using figures for typical plants, new and existing, they found that the break-even point was amazingly low. Beyond that, the study resulted in a formula which can be used by any plant engineer to determine whether air conditioning is worthwhile in terms of increased productivity for his plant.

Profitability formula. Use the two variable costs of air condition-



COMFORT-COOLED FACTORY in Florida reported production increases of 130% following installation of air-conditioning units

ing and labor wages to figure ratio of owning and operating costs per sq ft per year for air conditioning divided by salaries and wages per sq ft per year. This ratio equals percentage of increase in productivity you need to pay the cost of complete year-round air conditioning.

In this case, ratio of productivity to owning and operating cost replaces payout rate as yardstick.

As an example, installation of complete air conditioning in a typical new industrial plant costs about $3.13 per sq ft. Add taxes, insurance, principal and interest on first cost and the total owning cost becomes 31c per sq ft per year. Operating costs of 15c per sq ft bring total owning and operating costs to 46c. For the owner of an existing industrial building, higher installation costs raise this owning and operating cost to 55c per sq ft per year. Average industrial wages run to $36.10 per sq ft per year. Divided into owning and operating costs this results in required efficiency increases of 1.3% for new buildings and 1.5% for existing ones. Comparing this to the 9.5% increase for the government building or the 130% increase reported by one manufacturing plant makes justification of air conditioning fairly easy.

New high-efficiency equipment helps comfort cooling pay off

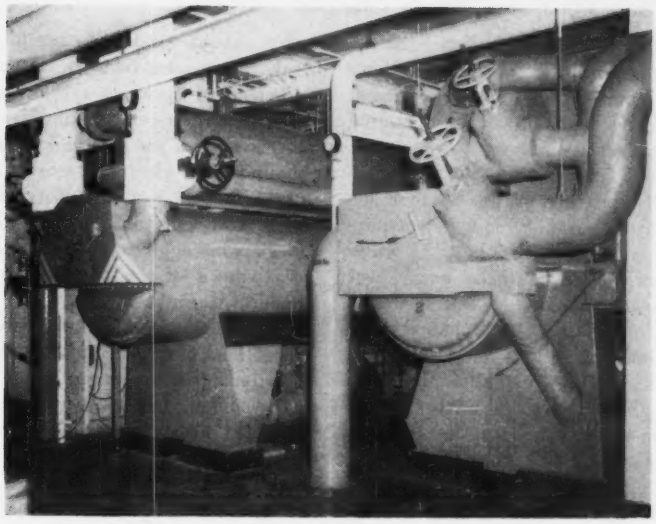
Once you've decided to install comfort cooling, you must select type of equipment to best fit your needs. There are three basic systems available to supply air cooling: straight compression-cooling cycle, heat pump and absorption system. Compression cooling teamed with boiler heating has supplied most plant needs to date, although both heat-pump and absorption-system installations have boomed in popularity and areas of application in recent years.

To choose the right system you must evaluate your rear-round heating and cooling demands. Selection now depends on an economic balance of area fuel costs, plant heating and cooling load, area electrical rates and total plant electrical load, since installed equipment costs are similar.

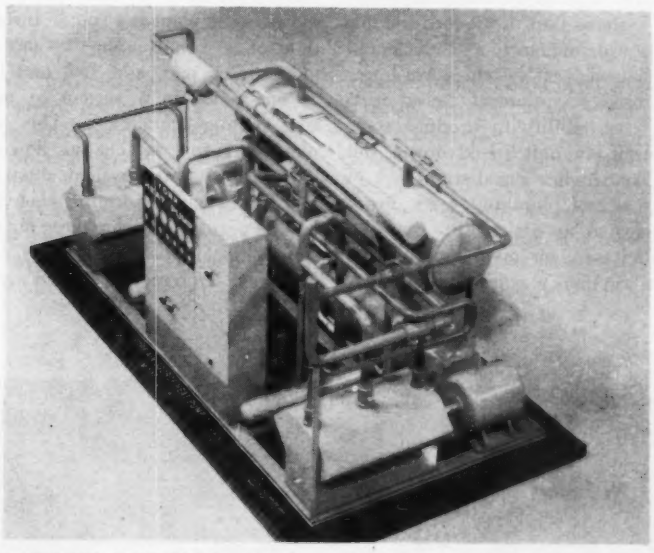
Compression cooling is the mainstay of the air-conditioning business. This system requires purchase of a boiler and a compression-cooling unit. It fits best in plants or office buildings with light total electrical load or high electrical rate, located in high-fuel-cost areas—light electrical load often makes power rate too high for economical electric heat (heat pump), and high fuel cost prohibits steam cooling. Main advantage is in form of fuel savings.

Size of cooling load has been a factor. So far, most cooling loads over 2000 tons use compression cycles. Areas with high cooling load relative to heating load may also lend themselves to straight compression cycles.

Heat pump gained recognition recently as a good bet for plants with large total electrical loads, small steam needs. Heat pump also shows up to advantage when simultaneous heating and cooling loads allow transfer of heat from one area to another. For the heat pump to pay off, winter electricity bill for driving compressors must be comparable to the fuel bill for heating. If this situation exists several other characteristics of heat pumps can be used to advantage. For instance, waste heat from process or plant air sources can be utilized



ABSORPTION SYSTEM handles heavy loads of centralized air conditioning. Heat comes from low-pressure steam, high-temperature water or thermal liquid



PACKAGED HEAT PUMP trims first cost of major equipment in an effort to balance rising labor expenses for installation of air ducts and controls

to reduce compressor power requirements. In winter months heat extracted from interior areas of building can help supply requirements of perimeter heating—this may be done through direct circulation of heated air to cooler areas. Waste heat may also be transferred to the compression-heating portion of the cycle through heat exchangers. These are some of the relatively "untouched" areas for plant savings.

Exhaust air from rest rooms, etc may not be recirculated through air-conditioning systems, so heat pumps have used this 80-F air to produce 130-F hot water for plant use. Where large quantities of fume-laden exhaust air or actual waste process heat exist, double-stage compression often required for winter heating can be replaced by heat exchangers and standard 1-stage heat pump.

Building costs can be reduced appreciably by use of heat pumps instead of the boiler-cooling cycle required by compression or absorption systems. In plants where floor space is a problem, entire heat pump and air unit can mount on the plant roof in otherwise wasted space. Combined saving in boiler room, fuel storage, etc can amount to over 1000 sq ft for medium to large installations.

Absorption units find their greatest application in plants where electric power consumption and fuel costs are low. Plants that have a process steam load may profitably operate absorption equipment, particularly when there is a possibility of generating byproduct power. For an example of this, read our description of the Parke, Davis & Co plant on p 81 of this issue.

Opportunities for fuel savings with both heating and absorption-cooling cycles show up in many plants. Absorption equipment requires about 250-F heat source for operation. A quick check of plant process cycles often uncovers wasted heat at usable temperature levels and a simple heat exchanger can trap this heat for use in local cooling units or one centralized system. If sufficient heat exists to supply all absorption-cooling requirements the entire system may be roof-mounted to save floor space. Basic difference between heat-pump and absorption-cooling use of waste heat lies in temperature level: where absorption equipment requires heat at approximately 250 F, heat pumps successfully utilize temperature levels as low as 80 F.

Packaged units cut installation costs for all three types. Initial packaging efforts concentrated on compression-cooling cycle, with units available in every size range. Packaged absorption systems and heat pumps currently available are in the intermediate size ranges. Heat-pump package shown at left includes control panel for automatic operation on heating and cooling cycle. Companion air unit, also mounted on skids, keeps piping and wiring to a minimum. Major field-erection costs tie to ductwork installation and local temperature and air-flow control.

Selection of the kind of air-conditioning equipment to fill particular plant needs eventually leads to the question of how much money to put into the entire system. Besides anticipated productivity increases many other factors enter your solution.

Basic difference between minimum-cost and high-cost optimum-performance systems lies in the area of control and operating flexibility. A minimum-cost system usually consists of a number of small packaged units with short duct runs or "free-throw" air discharge (direct discharge without ducting). Each packaged unit reacts to a locally-mounted temperature control. This type of installation pays off when the entire plant is constructed on a minimum-cost basis with an estimated usefulness of less than five years. Local units also pay in plants where manufacturing processes do not change appreciably and layout remains stable.

Optimum-performance systems also represent high first cost. For manufacturing plants with multiple process operations and estimated use spans of 20 years this high first cost is usually justifiable. Optimum systems entail centralized, integrated cooling and heating systems, air ducts throughout the plant and total control of various flows and temperatures. Where year-round hot spots exist optimum systems are capable of taking heat from one area and delivering it to cooler sections. The operating saving here is obvious.

When plant management decides to modify production lines, move departments around, add new equipment or make the host of other changes which normally occur over the years an optimum system really cuts costs. Almost any change made in plant operations or layout will unbalance air - conditioning loads throughout the plant. With an optimum system changes usually require only small modifications of ductwork or possibly just readjustment of controls. With minimum-cost systems any major plant change requires moving existing packaged units or adding others.

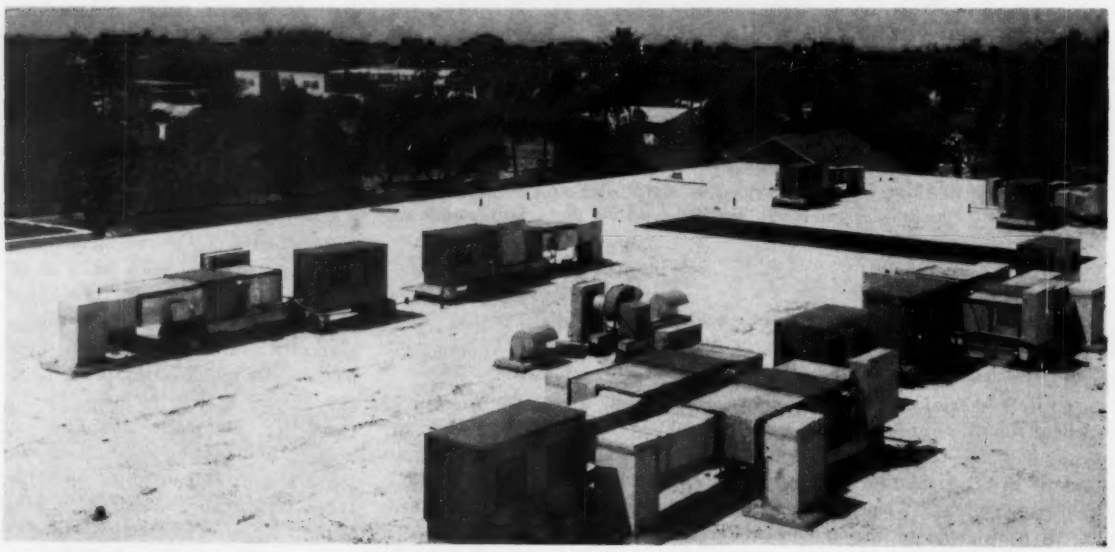
Basic arguments for and against optimum centralized and minimum local systems boil down to questions of cost, maintenance and efficiency:

Packaged local systems have lower first cost for equipment, lower operating cost, ability to produce some cooling if one unit breaks down. But you have higher installation cost of electrical and plumbing work, lower efficiency as an air-conditioning system and a bigger maintenance problem since there's more equipment to worry about—and all machinery breaks down once in a while.

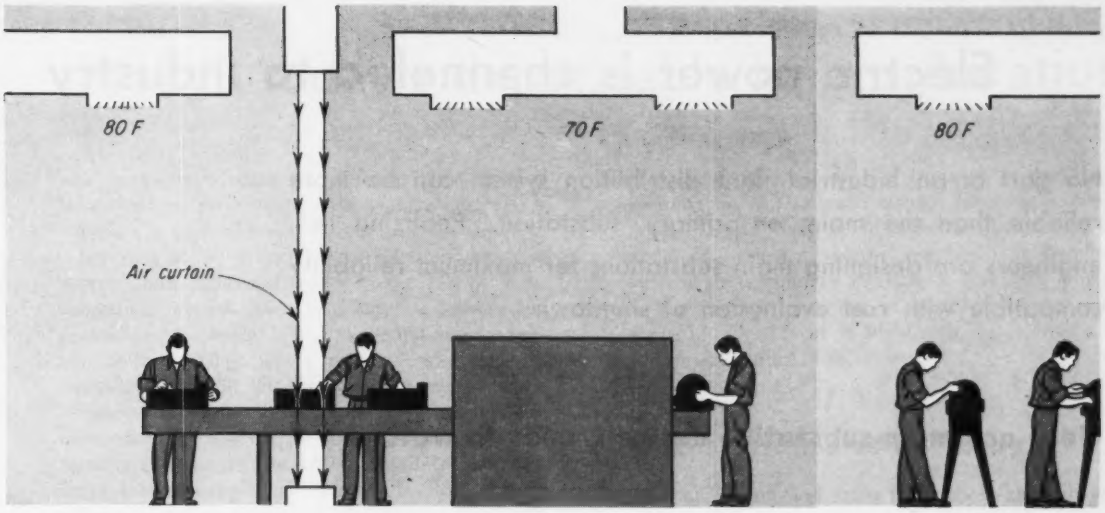
Centralized optimum systems give you a better air-conditioning system with more even air flow and cheaper plumbing and electrical work. But equipment first cost and installation cost of ductwork and control is high, and all your eggs are in one basket —breakdown of one key item stops all plant cooling.

Photo, below, illustrates installation of packaged local units in a 1-story industrial building. Multiple air-cooled units on roof connect directly to air-conditioning packages suspended from ceiling. This setup keeps piping to a minimum. In extremely compact factories such as this ceiling-hung packages conserve valuable floor space and multiple units spread out roof loading.

Local air-conditioning units also answer the need for specialized cooling of some plant hot spots. Installation of a heat-treating furnace or paint dryer may add sufficient load at one point in a system to make spot cooling economical. This technique prevents serious air-flow unbalances in main system ductwork and is particularly useful when heat load is periodic. Under these circumstances, local unit operates only when heat load is present and main system



LOCAL UNITS suspend from factory roof with minimum length of ductwork or "free-throw" air discharge. Air-cooled condensers for each local conditioning unit mount directly above. System cuts installation costs but lacks flexibility as factory loads change



SPOT COOLING supplies answer to problem of intense heat source in one area of cooled factory. Where air is not stirred up by cross traffic or drafts, temperature boundary remains. Agitated air may require air curtain to maintain temperature difference

remains balanced for basic cooling load of the entire plant.

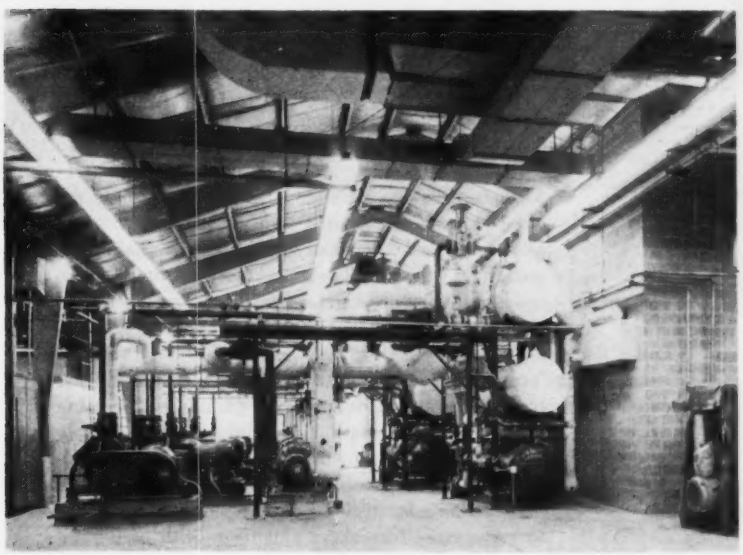
Spot-cooling problems and varying temperature requirements call for careful engineering of the overall plant system. This is an area in which experts—consulting engineers and manufacturers' specialists—can save you a great deal of money. For instance, temperature zoning of the type shown above is common in many industrial plants where furnace operators, welders, etc need lower temperatures for working comfort.

Careful design of air conditioning allows complete isolation of cooler area so there is no lateral heat flow. Where human traffic and moving machinery do not create air disturbances, air masses of different temperature will remain separate with very little dilution at the common boundary. Where air masses are agitated and a physical barrier is not possible or desirable, air curtains will prevent lateral air movement.

For high-bayed industrial buildings, designers often aim for lateral, laminar flow to keep air-conditioning costs down. By creating horizontal air flow it is possible to cool up to a predetermined level, say ten ft, and save cost of cooling the remaining ten to 15 ft.

When employing laminar-flow cooling engineers must keep careful tabs on radiant effects. Although workers are in an envelope of 70-F air, overhead steel and structure may be at 110 F. Unless the heat radiated from this overhead source is stopped workers still will be uncomfortable.

Whatever the final system you select is called upon to do, you would be foolish to arbitrarily trim cost. The difference in cost between an optimum and minimum air-conditioning system drops our 46c per sq ft per year to 40c. According to the evaluation formula, just 0.17% increase in efficiency will cover the extra cost for installation of the optimum system. This is an easy goal to reach.



CENTRALIZED COOLING system with complete control of air flow creates maximum flexibility, saves costly modifications if plant cooling needs change in coming years

Electric power is channeled to industry

No part of an industrial-plant distribution system can be more reliable than the main, or primary, substation. Realizing this, engineers are designing main substations for maximum reliability compatible with cost evaluation of shutdown

Here are main-substation design trends to watch:

- **Ownership** of main substations and responsibility for their design is passing more and more to the industrial plant on nationwide basis (see *Electrical Distribution Survey*, pp 106-110 this issue). But in some areas utilities usually own the main substation, at least transformer and primary switchgear.

- **Transformer reliability** is high; in substations with only one incoming power line two transformers aren't used. Installed cost of circuit breakers is much higher than that of transformers. With rare exceptions 3-phase transformers have displaced single-phase banks. Spare transformers are kept only in the largest plants with critical processes.

- **Fuse-vs-circuit-breaker** controversy is still lively among engineers. One fact is certain: circuit breakers are more expensive. In most cases, high side of transformer will be connected through fuse and switch or fused cutout. Low-side protection is nearly always a circuit breaker. Feeders may be protected by circuit breakers or fuses depending on time permitted by process to restore service.

- **Standardization** is state of affairs seemingly desired by everybody but it isn't always easy to agree on a standard. The packaged or unit main substation is catching on fast, however. Some large industrials try to standardize on a particular kva rating, duplicating if necessary.

- **Voltage and kva** continue to climb. In some areas transformers with dual-voltage primaries are being installed in anticipation of doubled utility supply voltage, see p 97. Low-side (plant primary distribution) voltages are often in the 13.8-kv range these days. There is steady pressure on manufacturers to make circuit breakers and fuses with higher interrupting ratings; some engineers look to equipment, not complex circuitry, to handle huge loads.

POWER's editorial program, Power to Grow . . . *electrically*, begun in September 1956, promotes design for growth with minimum initial investment in equipment. To aid in measuring a plant's ability to expand electrically, the *PTG* index was devised. Planned-for capacity that can be economically provided and later integrated into system, divided by installed capacity, gives us a *PTG* index for a guide.

through today's dependable main substations

An industrial's main or primary substation is located where power enters the plant electrical-distribution system. Usually this means the point of connection to a utility company's lines, or to a supply from industrial's own power plant. Main substations always have disconnecting means and protective equipment in the incoming line, metering, a transformer where needed and protective equipment for the low-side circuits (main-circuit-breaker and feeder protection). The cases we're discussing in these pages always involve a transformer, whether its low-side voltage is a plant primary-distribution voltage of 2.4, 4.16, 13.8 kv or a 480-v utilization voltage distributed from main sub.

Circuit arrangements

Degree of reliability required for the manufacturing process is the principal factor in determining type of circuit required in main substation, as it is in remainder of plant's distribution system. But cost rises rapidly as circuit complexity increases, and the cost of reliability must be weighed against cost of interrupted production. An idea of relative cost of the several schemes described on pp 94-96 can be approximated by comparing number of circuit breakers and transformers involved and noting whether fuses or circuit breakers are used. Other factors will depend on the particular situation. For example, the utility may have two lines available at your plant; if not you may find that obtaining a second line is prohibitively expensive. Economy in main substation design is an accelerating trend of which utilities are especially conscious. They have wide experience as to where economies can be effected. You, as a plant engineer, naturally don't want to pay for unnecessary frills, but you don't want to be caught short by a shutdown you can't afford, either.

Always work in close cooperation with your utility. It's important to know the history of outages on the lines supplying you. In general the power company will specify minimum protection required on the high side of the transformer (which chiefly serves to protect their lines). Often they will provide services of a relay engineer to coordinate your system. Beyond utility requirements you may want additional protection; many engineers want fuse protection on transformer incoming side unless a breaker is used. But in many cases it's possible to rely on utility's protection out on the line.

Power companies try to maintain voltage swings within fixed limits, and in many states limits are prescribed by law. This "guaranteed" voltage regulation may not be good enough for your process, however, and then you'll have to do something about it. Usually voltage regulation is handled best at the secondary substation providing power to the critical load, but in some cases you may want to correct on a plant-wide basis, using a load-tap-changing transformer.

Main substation design today

Standardization and mass production have advantages which have boosted the packaged or unit main substation into popularity, see p 99. Limited available space is another factor. Majority of subs today are outdoors; some are half-and-half with low-side switchgear indoors. Where utility supplies transformer it's likely to be oil insulated; if you want askarel you'll have to pay the difference.

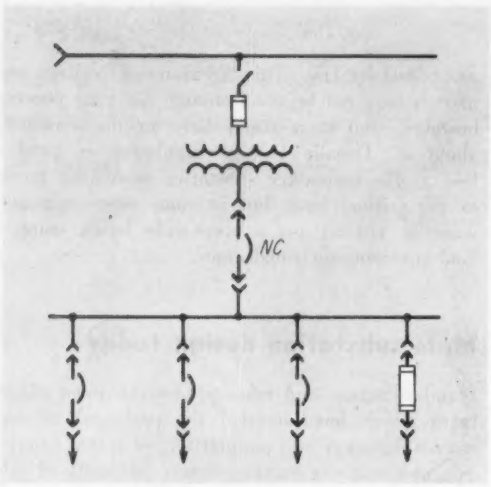
Grounding practices are still undergoing study by power companies. System grounds on the low side continue to gain adherents, but there are still some notable holdouts among plant engineers with critical loads to watch over. Resistance grounding of system at single point (such as at transformer wye) is most favored method. Equipment grounding is important: some utilities require as a maximum ground resistance not more than two ohms. Fence may be grounded independently. Electrolysis is a serious problem in some parts of the country and ordinary bare copper ground rods may be inadvisable. Look into conditions in your area and adapt methods accordingly.

Location of metering, on primary or secondary side of transformer, depends on utility policy. If you own main substation, metering will probably be primary. With secondary metering there is usually some rate factor to cover sub losses.

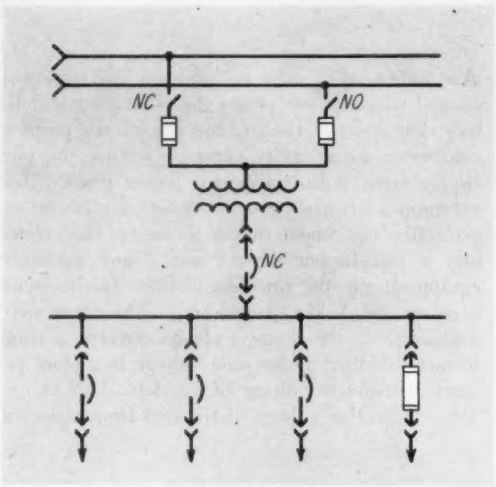
Advances in components

Three major components, transformers, switchgear, relaying, are looked over on p 100. Lightning arresters play key role in protecting transformer, should be close to it. If overhead arrester is more than 130 ft from transformer a second arrester should be used. Location of arresters must take into account effectiveness in handling reflected voltage waves. Higher-cost station type arresters may pay off where lightning is frequent hazard. Some engineers are grounding arresters through structure instead of overhead ground wire.

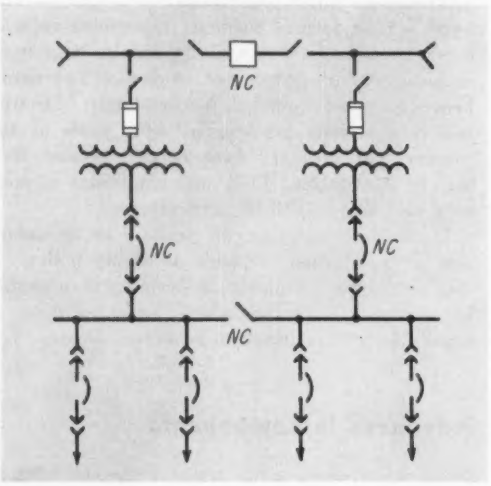
Although a simple radial, single-transformer setup meets most needs,



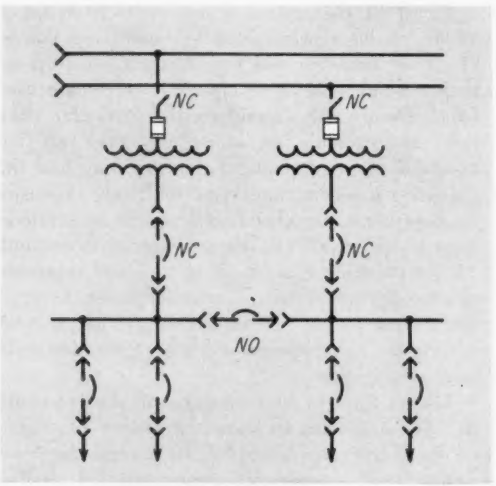
1 Simple radial primary fed from single power line takes care of most plants. A fused cutout or switch followed by a fuse will disconnect the transformer in case of transformer fault or line surge that might be caused by lightning. Main circuit breaker on low side protects the transformer from overloads and bus faults. Some feeders may be fused



2 Two power lines, where available, mean greater reliability. Transfer is usually manual, but can be motorized for remote restoration of service. Some power companies favor this circuit since they can kill a line for servicing. A single fuse or cutout is often used but this defeats one advantage of scheme. Feeder fuse is a metalclad drawout unit

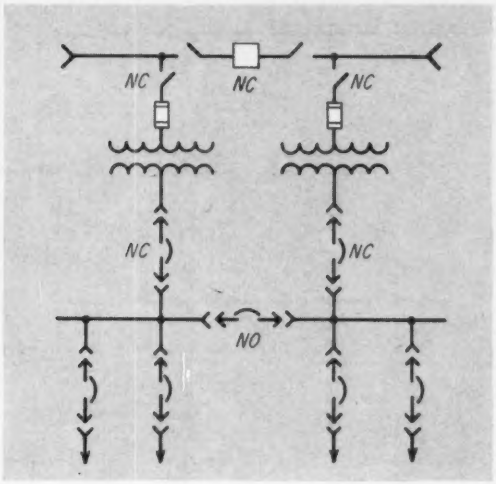


5 Normally closed tie saves a breaker and there's no power interruption (noncritical loads may be dropped if transformer reserve isn't 100%). However, advantage of lower short-circuit capacity of split bus is lost. Switch is used for maintenance outages. In circuits *3* and *5* fuses are sometimes omitted on the primary side of transformer

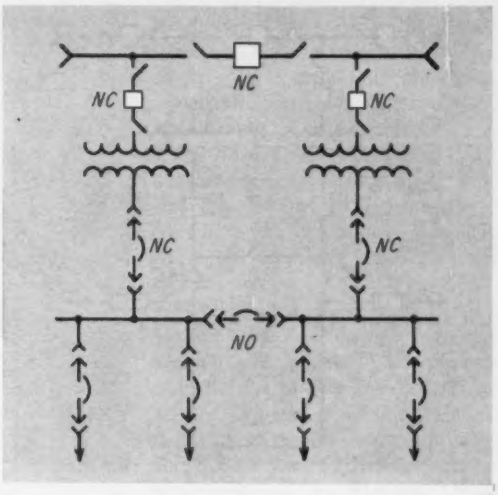


6 Tie-breaker arrangement can be set up with two power lines where distinct sources are not available. It's also the lowest-cost layout of a 2-transformer substation that takes advantage of splitting load. Failure of line or transformer causes its main low-side breaker to trip and tie breaker automatically closes, in same manner as circuit *3*

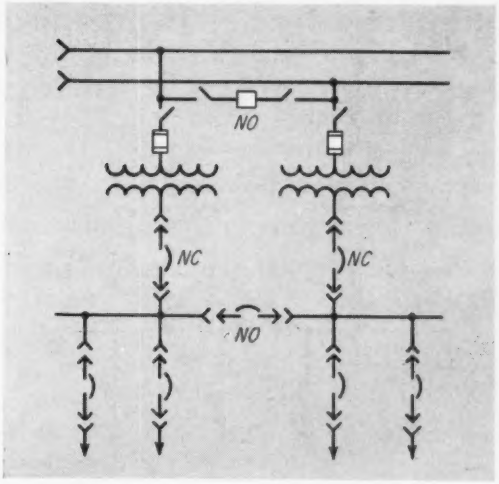
more complex circuitry is a must for critical process loads...



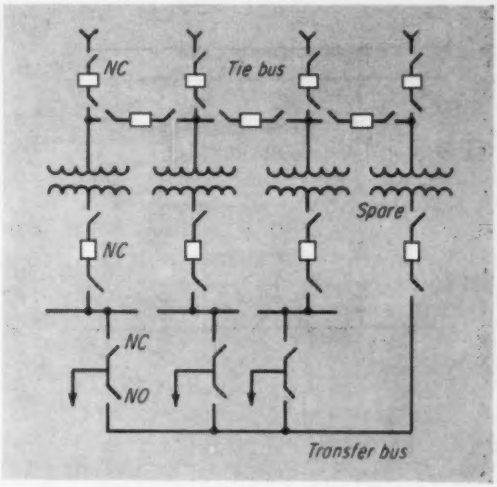
3 High reliability for critical processes is usually obtained with some modification of this circuit. Two power sources come from utility's subtransmission loop, from different utilities or from utility and company's own power plant. Sectionalizing breaker handles power transfer in line, automatically disconnects the line which is defective



4 Completely automatic operation can be had at substantial increase in cost. Tie breaker circuits (sketches *3* and *4*) normally split the load. On failure of line or transformer, left, main low-side breaker opens and tie breaker is closed. Size of transformers and main low-side breakers depends on how much of the load can be dropped in crisis



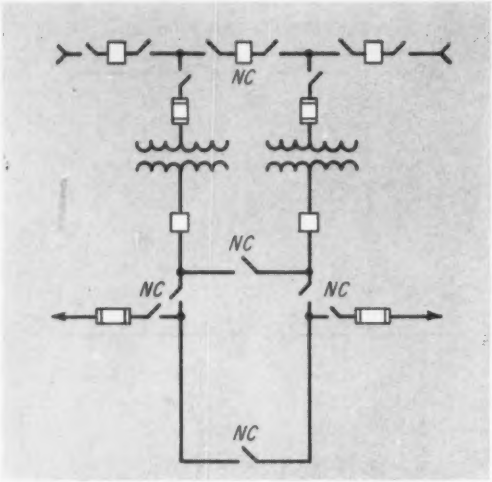
7 Supply-line tie can be used where either line can carry full load of both transformers (and cost of the breaker is justified). High-side tie breaker closes only when one line is dead; both transformers carry normal load. If transformer fails, low-side tie breaker picks up load as in *6*; some load is dropped or transformers will require 100% reserve



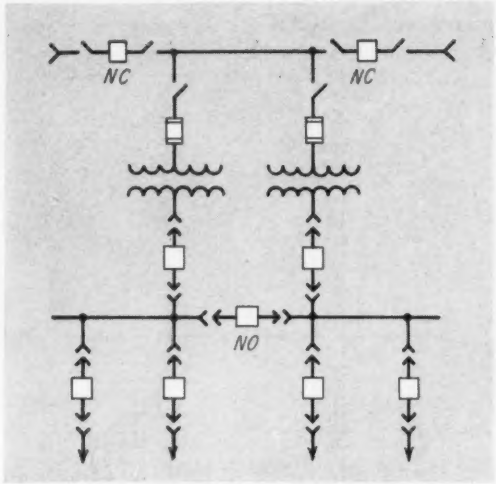
8 Multiple power sources of largest plants lend themselves to super-reliable circuits like this. High-side tie breakers are operated open or closed depending on conditions of power interchange. Spare transformer connects directly to transfer bus. Autotransformer may be needed in addition to equalize voltage of different sources on tie bus

...with alternate feeders a prime consideration

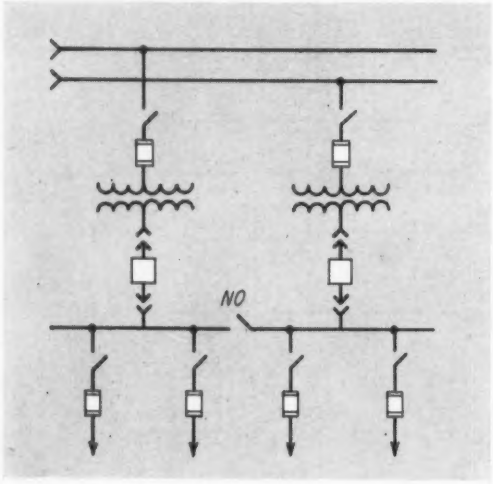
Selection of top-quality equipment with provision for growth...



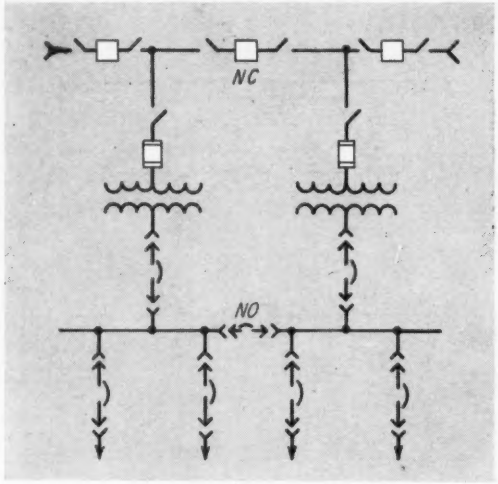
9 Loop circuit is adopted in conjunction with 480-v secondary loop for greater dependability. Circuit breakers in high voltage are not essential; air-break switches are more likely candidates unless power company requires breakers. Scheme as shown makes maximum practical use of fuses in high- and intermediate-voltage distribution loops



10 Primary selective scheme has been adopted by one manufacturer as a standard: it's a variation on circuit *3*. System is secondary selective also, with double-ended substations and tie breakers. Number of feeders is not limited to four, of course, in this or other circuits discussed. Scheme uses circuit breakers; fuses are for extra protection

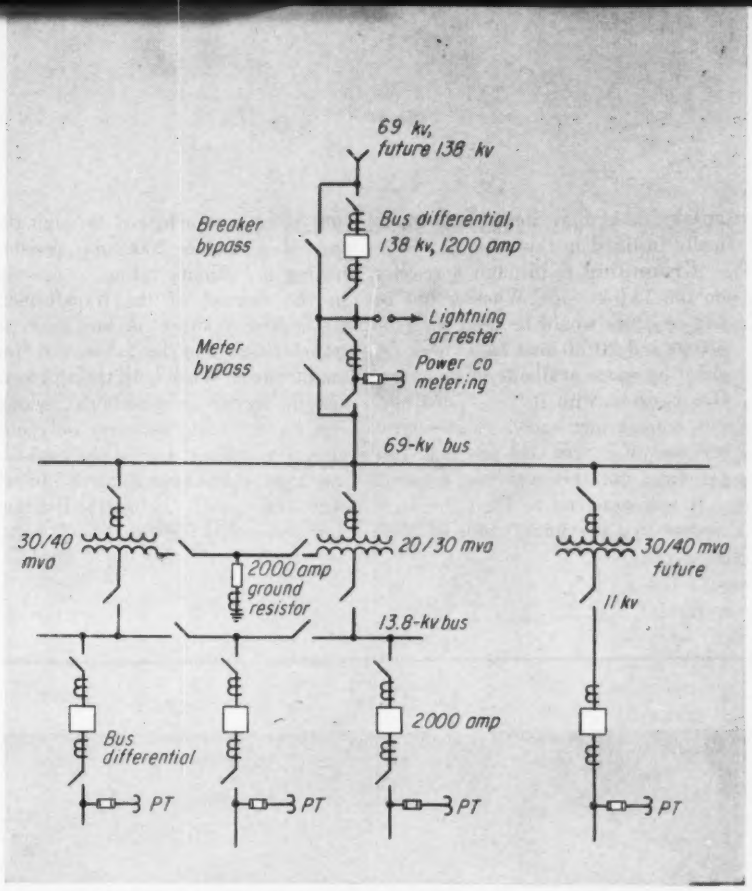


11 Fused feeder arrangement is a modification of circuit *5*. Some of the feeder circuits supply double-ended secondary substations, others carry single-ended subs. Magnetic air or molded-case circuit breakers in the secondary subs are coordinated with feeder fuses. Replacing the main low-side breakers with fuses has only a few advocates



12 Automatic scheme for main substation with two power sources is a variation on circuit *4*. Both transformers can be switched to either supply line without interruption, and the other supply line is automatically disconnected; or each line can carry a transformer. If one transformer fails, the tie circuit breaker on low side closes to pick up the load

...is still the key step in substation design



NEW 30/40-MVA TRANSFORMER will be added later to meet growing power needs

Expansibility is fast becoming major factor in planning any main sub

Continuity of service, with power-to-grow and the prospect of the utility company doubling its supply voltage, were problems solved in design of new steel-tube plant

Service continuity, safety, efficiency, low maintenance and reasonable first cost were prime considerations in design of the electrical-distribution system for the new blooming mill and melt shop of a leading steel-tube manufacturer who is alert to future industrial expansion. Present trend toward fewer operating people pointed up the increasing importance of these factors.

First item considered was voltage level at which power could be purchased. No power is generated in the plant itself. As is normal, the power company specified interrupting capacity required for primary circuit breaker and the voltage rating of this breaker. Power company would provide only one incoming service, which was 69 kv. All circuit breakers at this rating were required to have an interrupting capacity of 5000 mva. Furthermore, the power company stated that in about eight or ten years a new generating station would be built nearby and therefore all 69-kv equipment should be suitable for conversion to 138 kv in the future. When conversion is made interrupting requirements will change from 5000 to 10,000 mva.

Outdoor OBC rated 138 kv, 1200 amp was selected. This breaker is designed so that it can be converted to 10,000 mva interrupting capacity simply by changing breaker's interrupting units.

Metering equipment used by power company consists of individual current and potential transformers instead of a standard metering outfit. The demand meter is a 2-element type with 15-minute demand registers and 1.5-kw charts. Bypass switches were required for metering transformers so they can be taken out of service for maintenance. Note also that lightning arresters for the 69/138-kv line are placed on the opposite side of the circuit-breaker isolating switches so they can be taken out of service for maintenance.

Space was left for future capacitors or buffer reactors. This was done as a precaution should lamp flicker develop after arc-furnace plant went into operation.

Dust and corrosion problems are severe; therefore all equipment insulators, transformer and circuit-breaker bushings are the *extra-creepage* type to eliminate flashovers and extend maintenance periods.

Transformers were selected with power-to-grow in mind. Initial load is approximately 47 mva of arc-furnace load and about ten mva of synchronous-motor and other blooming-mill loads, for a total of 57 mva. Using a diversity factor of about 80% two transformers were specified, one rated 30/40 mva, the other 20/30 mva. In future, about 36 mva of arc-furnace load will be added and a new 30/40-mva power transformer installed. Transformers are shell-form design having series-multiple primaries suitable for present 69-kv and future 138-kv service. They are equipped with forced-air cooling controlled automatically from contacts on the hot-oil thermometers. A sudden-pressure relay for internal fault

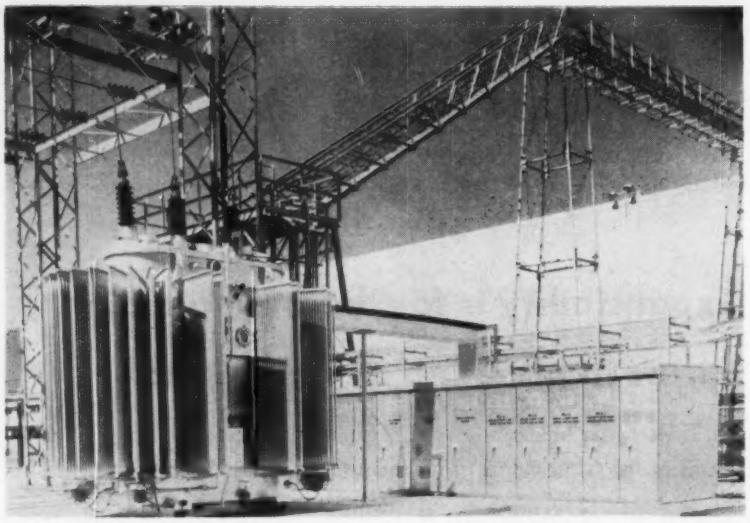
detection is provided and mounted in the gas space above oil level. Each transformer has current transformers on its high-voltage bushings for relay overcurrent protection and a low-voltage neutral bushing for external connection to a grounding resistor. Transformer impedance is about 9%. An isolating switch on each unit simplifies maintenance.

A primary circuit breaker is not provided for each transformer. Although individual primary breakers are desirable, they were not economically justified in this case.

Grounding is through a resistor on the 13.8-kv side. Whether one or two resistors would be used with the 30/40 and 20/30-mva banks was decided by space available in structure. One resistor, with its associated current transformer and overcurrent relay, will of course cost less than two resistors, but this was not decisive.

It was practical to limit the fault current to a maximum value of 2000 amp. This was achieved through the use of a 4-ohm 2000-amp resistor having a 1-minute rating, connected in the neutral of the transformer. Grounding resistor is switched so transformers can be taken out for maintenance. When both transformers are in service ground-fault current will be the same as when only one unit is operating. Use of the grounding resistor has been the trend in recent years with industrial-distribution systems of 2300 to 14,400 volts.

What can you do when load grows too big for your main substation?



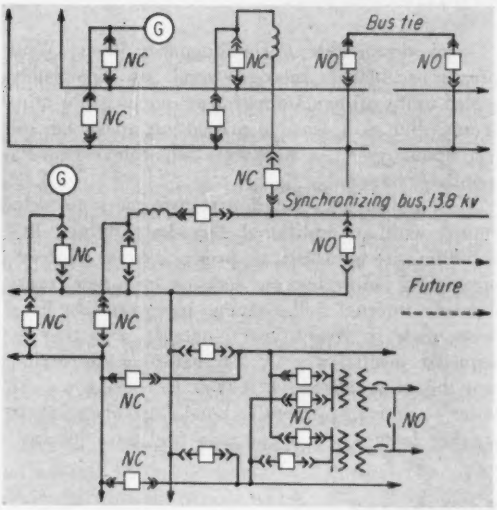
DISTRIBUTION FEEDERS at 4.16 kv are interlocked armor cable carried by bridge over road and then in cable rack across roof to plant. Older distribution is underground

This is what happened at the Fort Worth, Texas plant of Convair Division of General Dynamic Corp. Original setup had two main substations serving the plant, with a 60-kv bus structure spanning both substations, which are about 100-ft apart. One station is equipped with three 3333-kva 60/4.16-kv transformers, the other with four, one of which is a spare. A rail type transfer car connects the two substations so spare transformer can be moved quickly into position when needed. But in 17 years of operation they have never had occasion to use the spare.

When load outgrew the original installation, even when boosted up to 23,000-kva capacity by cooling fans, a third substation was added between the original two. It's a new 60-kv bus structure, with 10,000/12,500-kva (with cooling fans) 3-phase transformer and metalclad weatherproof secondary switchgear.

Feature of interest in the new setup is unusual method of secondary-feeder distribution. Original distribution was entirely underground from substation to buildings. When planning the new installation all manholes were found filled and underground interference prevented further installations. Also, a main service road runs between substations and main plant. To overcome these obstacles a cable bridge, including catwalk, was built over the road with about 50-ft clearance for vehicles. Interlocked armor feeders are carried in cable trays across roof to a monitor section inside the plant.

Here's a plant that generates all its power



SIMPLIFIED SECTION of plant's distribution system: generators and load connect through synchronizing and tie bus

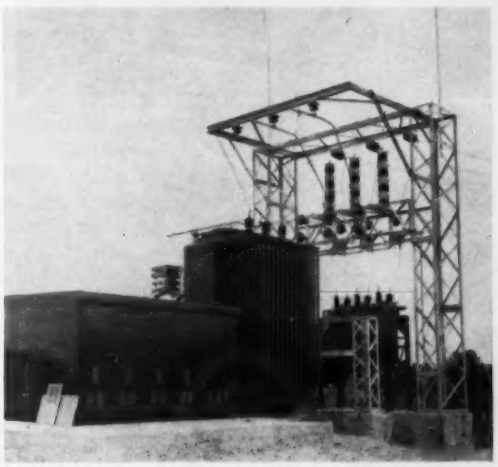
Distribution system in a leading chemical plant that generates all its power was designed for top service continuity. Judging by number of circuit breakers alone, you can see it represents a large investment—and cost of shutting down continuous processes justified the investment. Basic pattern is duplicated in other parts of the plant: each local area is fed from a double bus, served directly by one generator and tied to other generators through synchronizing bus. Also, there is a normally open tie bus between double-bus distribution sections.

Substation at bottom of sketch, left, is typical of those serving most critical continuous-process loads. Each bus is operated secondary selective with normally open tie breaker. Each transformer (capable of independently carrying total load) is normally served from both service buses. Primary-selective arrangement permits continuous service should primary bus fault occur. Only a fault on the load bus can kill the load.

Packaged main substations simplify engineer's task

Having taken a look at some design problems and how they were solved, let us see what main-substation equipment is available today. Packaged substations are offered which are "pre-engineered" in most respects and make it easy to standardize and provide flexibility and power-to-grow. Equipment on high-voltage side can't be unitized like low-side gear, but standardized components offered by several manufacturers can readily be assembled to meet your particular needs.

Typical packaged sub includes prefabricated steel structure (aluminum is getting attention), lightning arresters, disconnecting switches, buses, potential and current transformers, hardware, etc. Metering, outdoor oil circuit breakers or fuses, relaying, control cable and the unit low-side equipment are part of the package. Unit substation includes transformer, metalclad switchgear and associated components. While the high-side gear is nearly always outdoors, unit substations may be in or out depending on your requirements. For outdoor stations an enclosed aisle for maintenance is gaining wide acceptance. Aisle is wide enough for two breakers to pass each other side by side within the structure.



Along with packaged main substation manufacturer includes drawings: foundation, arrangement and erection plans, wiring diagrams, conduit layout. Packaged subs will probably save you space.

Major substation components keep improving

→ Transformers . . .

. . . are dependable, low-maintenance items. With pressure-regulated inert-gas seal or completely sealed units, oil contamination is reduced to a minimum. But as a sensible precaution, make lab oil test annually—some engineers advocate every six months to be safe.

Most industrial substation transformers are self-cooled with an additional forced-air rating. But you'll be wise to investigate pros and cons of forced-oil cooling before making decision on a new transformer. Internal dollar-saving improvements have been made in recent years, notably reduction in required insulation. (A 2-transformer substation may be more attractive if you can make use of lower-cost transformers.) Load-tap-changing is another feature which you may find pays its way.

→ Switchgear . . .

. . . is keeping pace with ever-tougher jobs put upon it by huge loads and short-circuit capacity. Main low-side circuit breakers, to 15 kv, are available with 1000-mva interrupting ratings, and 1500-mva ratings are around the corner. Current-limiting fuses have reached 10,000-mva interrupting.

New insulating materials in metalclad units aim at electrical properties of porcelain while keeping mechanical and forming advantages of a plastic. High-grade polyester glass and special epoxy compounds are pushing out phenolics.

New design air-blast breakers may see wider adoption in place of oil. Lighter weight, smaller size, reduced maintenance are advantages. Right now they'll interest only largest industrials.

→ Relaying . . .

. . . has become highly specialized. Needs of most plants can probably be met with selective-tripping over-current relays, but some engineers strongly advocate differential relaying for transformer protection. Opinion is divided on sudden-pressure relays. They're gaining popularity, however, and in a few years a better evaluation should be possible. Differential bus relaying is expensive but is justified for high-reliability systems.

Relays are undergoing a revolution as result of new static elements. Static relays can function in microseconds, eliminating mechanical inertia. Coordination is easier over a wider range. Smaller size and less maintenance are other advantages. A fault detector that measures resistance instead of current is under development. Other novel approaches to relaying can be expected along soon.

New industrial instruments and controls speed full automation

Industrial power services have lagged behind the utilities in application of instruments and controls. To a certain extent this lag came about because of a tendency to develop control-system technology in the field. Since few industrial plants could afford to purchase controls or instruments on a pilot basis, most development work occurred in the utility field. At the same time, justification of instrumentation first cost is partially dependent on capacity of equipment to be controlled, so smaller plants could not justify full automation.

Today's picture of industrial instrumentation is much brighter. Fringe benefits from research in military instrumentation, process control and basic systems analysis are evident in a new generation of industrial controls. These controls stress simplified, infrequent maintenance and calibration. They are designed with the wildly swinging loads of many industrial plants in mind.

Beyond actual hardware improvements, new techniques of system analysis are paying off in the form of fewer unnecessary controls, better matching of control-element characteristics and system response. Several years ago one control manufacturer started analyzing industrial power-plant cycles on a control-system simulator. Since that time several other control manufacturers, consulting-engineering firms and plant engineering divisions have acquired system analyzers.

Prime target of development work is improved control of spread-out plant services. Sprawling electrical, steam, air and refrigerant lines are characteristic of many process industries. The problems found at American Cyanamid Company's Bound Brook plant are typical. Process lines utilize some 800 different chemical operations, with production runs of a wide variety of material. Under these circumstances plant services to any given area of the plant vary considerably. Changes may be sudden and of large magnitude. In attempting to balance overall plant load and also react instantly to demand from one point, plant-services controls are taxed to the limit of their ability. In turn this places an increased supervisory load on operating personnel.

In any attempt to supervise plant services from one central location, system designers must minimize the number of variables which have to be centrally controlled. At present, system analysis is concentrated on discovery of key variables and prime control functions. Result should be remote-control loops, normally requiring a dozen or more interconnecting control lines, which operate with just a pair of interconnecting channels or lines. All other variables would be controlled by closed-loop systems dependent upon ultimate control by one or two master loops. Techniques involved in this type of remote system are a result of work done with systems analyzers, and represent first steps in the direction of better industrial control.

Centralized control received its biggest boost from recent supervisory-control installations. Remote indication through telemetering, reset by selective channels and the ability to start or stop remotely help cut operating costs to bare minimum.

In general, supervisory systems are built up to meet requirements of a particular plant. Some packaging of components shows up in panel consoles for master and remote stations. Panels are available in steps of channels or sampling points. For example, one remote station can handle up to 20 different points. If 21 points are desired, a second 20-point unit must be installed. Although the 21st point involves an extreme incremental cost, possible expansion of channel needs at a later date often justifies this first cost.

Supervisory data centers in packaged form are becoming particularly popular in comfort cooling and plant heating. In the past few years over 400 systems have been installed and an increasing number of plants, buildings, etc are making use of this answer to the problem of decentralized equipment. Since supervisory control merely adds on to existing control and instrument loops, it does not require special instrumentation.

One packaged unit includes selective control of basic circuits by pushbutton operation. As an operating engineer pushes the button for a certain portion of the plant system, a schematic diagram projects on a screen. When a particular diagram projects on screen, operating controls on the console simultaneously switch to system represented on the slide. By means of console controls operator is able to adjust set point of any control in the system projected.

Computer control of industrial power services appears as a far-off goal to many engineers—cost of computer controls for central stations seems too high for the average industrial plant. For many installations this is quite true, but there are special circumstances which make computer control possible. Control of certain process operations is economically feasible. If computer control of power services was included, the overall computer cost would be reduced. Another answer to the cost question lies in use of smaller, special-purpose computers. Where computer is used for set point adjustment, slower speed is no problem. Other controls operate satisfactorily during the time lag, preventing dangerous or poor operating conditions.

ACTIVATED SLUDGE plant handles waste treatment for American Cyanamid's Bound Brook Works and surrounding communities

Industry tries new waste treatments

Industrial waste treatment is becoming an increasingly important part of the power services. As plants huddle along available rivers, bays and large lakes, concentrated wastes present a water-pollution problem. Years ago, water pollution was not the engineering or community-relations problem it is today. But as a result of anti-pollution laws and a desire for top community relations, many of the larger industrial plants now return process water to the source in a better condition than they receive it. To do this economically required development of special processes designed to treat plant effluent. At present industrial plants have developed new primary-treatment techniques and two economical secondary waste treatments.

Waste pre-treatment usually consists of some form of chemical neutralization and filtration. New developments in this area come in the form of improved designs for automatic treatment, including fully automatic, continuous chemical analysis of plant effluent. In turn, analysis on a continuous basis allows fully automatic control of chemical

AERATION TANK is one of six biological oxidizers

additives as they feed to the neutralizing station.

Chemical analysis of plant effluent on a continuous basis is complicated for even those plants where pollutants are few and relatively constant. For chemical plants, where waste products may vary with each production run, it frequently pays to introduce chemicals at several points in plant waste system. By this method effluent from particular plant processes can be treated before it enters main waste lines and analysis is simplified.

Activated sludge treatment plant at American Cyanamid Company's Bound Brook Works represents nearly ten years' intensive development by plant engineers, including operation of several pilot plants. The final result is one of the largest biological industrial waste-treatment plants in the world. Largest and most flexible of its kind ever constructed in this country, system could treat the wastes of a city the size of Cleveland. Plant wastes come from 800 different chemical operations during which company uses and returns about 20 million gpd of river water.

Operating as a secondary treatment plant, the new facility consists of six aeration tanks and six final settling tanks. The aeration tanks cover nearly four acres. Each is 65x400 ft and 16-ft deep. Rows of nozzle type aeration diffusers line the bottom and wall of each tank. Final settling tanks are 80 ft in diameter by 10-ft deep and are equipped with vacuum sludge collectors. Air for diffusers is supplied by two 25,000-cfm centrifugal blowers.

Besides treating plant's entire effluent, Bound Brook's system supplies secondary waste treatment for three neighboring municipalities. Entire discharge tests out purer than plant water as it comes from the river intake tube.

Sludge-combustion method eliminates conventional filters, chemicals, sludge-digestion units, incinerators and auxiliary equipment. It also reduces space requirements for secondary systems.

System, titled the Zimmerman process, is a radically new method of combustion which operates on the basic principle that organic matter contained in a water solution can be oxidized and its heat value released for efficient use. In a continuous operation under 1200- to 2000-psig pressure, process oxidizes organic matter with air while it is dissolved or suspended in water. Same degree of combustion is produced with water present as achieved by first evaporating water and then incinerating dried residue. End products in either case are steam, nitrogen, carbon dioxide and ash. Since exhaust products are water-washed, gas is ash-free and odorless.

A fuel liberates heat only when it burns with air. Probably because it costs us nothing, we do not generally realize that air is just as important to the combustion process as fuel. When fuel is contained in a waste material, a new approach to fuel economics is suggested to the plant engineer: the *fuel* is free—problem is to get the right proportion of fuel to air under the required pressure. Next step runs the mixture into a reactor so that combustion will be brought about at a speed and temperature that either produces the most heat or eliminates the largest amount of organic waste, or both.

Economical operation of the Zimmerman process depends on efficient use of developed heat from combustion. This is in the form of generated steam and exhaust gases. By using power-recovery units cycle can be made self-sufficient. When waste contains sufficient volatile matter, process will not only produce steam or power to run the cycle, but excess steam may be fed to plant steam lines or turbines. If process operates at 1200 psig with sludge containing at least 6% solids, it will require outside steam and power for starting only. The process becomes thermally self-sustaining if sludge containing 3% solids is available.

Although originally developed with municipal waste-treatment plants in mind, the Zimmerman process is extremely interesting to industrial plants due to the small space required and the self-sustaining characteristics of the thermal cycle. First industrial applications are for paper pulp mills, where waste pulp liquors are fuel. In one such plant, the sole purpose of installing the Zimmerman system is generation of needed process steam.

"Hands-off" lubrication gains followers

During the past 12 months the plant lubrication engineer has watched, and in a few cases been part of, several significant developments. He has seen new lubricants introduced to handle higher bearing loads at higher temperatures . . . he has seen suppliers increase activity in the important field of solid lubes . . . he has seen further advances made in oil-less and sealed-for-life bearings. All these promise him better days tomorrow, but today he still must cope with existing equipment. And his biggest problem in this area is people.

For years the lubrication engineer has been trying to get management to invest in better-quality oilers rather than men who are just a cut above sweepers. He has met with mixed success. Where plants invested in the more intelligent, better trained man for application of lubricants they generally got their money's worth. They found they had bought a spotter of potential trouble as well as an oiler. They found they had a man who took an interest in the why, as well as the how, of his daily work.

But with climbing labor costs facing them, some lubrication engineers are proposing even more extensive adoption of centralized systems to eliminate the oiler where possible. In the minds of many we are now in an economic climate where it becomes increasingly difficult to afford the luxury of an oiler. Naturally the manufacturer of centralized lubrication application equipment greets this kind of thinking with open arms since he knows it's entirely possible to supply a no-handling lubrication system. Such a system would take bulk-delivered incoming lubricant from the oil supplier, distribute it throughout the plant, meter it, carry it to the bearings, then see to its disposal after the lube has served its purpose in bearing or gear train.

Another move to eliminate the oiler comes as a result of wider adoption of sealed-for-life bearings. This becomes more appealing as lubes and bearings continue to improve.

Today, a growing number of industrials are leaning on both techniques to give them what they need: the right lubricant, in the right quantity, in the right place, at the right time. And they are becoming more convinced this can be done best, and at lower cost, without the oiler.

New concept aims at low-cost gas-turbine power

As this issue goes to press, a unique gas-turbine power plant is taking shape in the Mt Vernon, Ohio, shops of The Cooper-Bessemer Corp. Its major elements are familiar: a Pratt & Whitney *J-57* jet engine and a Cooper-Bessemer power turbine. The new concept lies in linking the two—using the massive thrust of a quantity-produced aircraft unit as "power gas" to drive an industrial type output turbine. Result is an efficient, simple, extremely compact plant rated at 10,500 hp.

When the idea of such a combination occurred several years ago to Ralph Boyer, vice-president and director of engineering for Cooper-Bessemer, advantages were apparent. The modern aircraft gas turbine, as a result of a tremendous investment in development, is a highly refined power plant with an impressive service record. Even without regenerators, jets for commercial service show surprisingly high thermal efficiencies. And quantity production materially reduces unit cost.

There was clearly much to be gained by using such a fully developed unit as the gas generator of an industrial gas-turbine plant, but could a lightweight aircraft engine be applied to long-life stationary service? Intensive analysis by Pratt & Whitney engineers revealed that many of the design features that make for high specific output also work to increase service life. With inlet temperature reduced from the 1800 F needed for peak-performance take-off conditions, at least 8000 hours between overhauls can be assured.

The power plant now under construction is intended for gas-transmission service. In it a *J-57* engine rated for operation at 1400 F discharges through a short transition section to a Cooper-Bessemer-designed power turbine driving a centrifugal compressor. The *J-57* combustion system has been modified to burn natural gas from the pipeline. At 1400 F, and without a regenerator, the plant is expected to attain 25% thermal efficiency.

This performance without a bulky regenerator will permit savings of more than 50% in the first cost of station building and auxiliaries. While it is too soon to be sure, expectations are that first cost of the gas-turbine plant itself will also run less than a conventional unit. Finally, it is anticipated that substantial savings in maintenance cost and downtime can be achieved by adaptation of fast-turnaround procedures used by airlines.

First plant of this type will be installed at the Clementsville, Ky. station of Columbus-Gulf Transmission Co; watch for a full story in POWER.

Power OCTOBER 1959

Industrial Plant Design Survey

Design features listed on following pages are from newly completed industrial plants, modernized plants, from some still under construction, others yet on the drawing board. Survey covers three power areas: *electrical distribution, industrial power generation, air conditioning.*

Electrical-distribution report, which starts on the following page, is second of its kind to appear in print; the first was published in POWER, October 1958. This year you will find even more of the electrical design features power men are interested in now. Report includes electrical details in the plants surveyed from the incoming main or primary substation through the circuitry to lighting and motor loads. A brand new addition this year is the air-conditioning tabulation covering 44 installations.

But because of the way we must compile facts the survey has its limitations. We started the job by listing installations planned or on order. We then sent questionnaires to those individuals closely allied with each project asking for engineering details. Replies went into the tables. So, by the very nature of things, you can see that these tabulations can't be complete. But since they're representative of current design and construction, you do get useful information on current trends.

So once again: these are not complete lists, but extensive samples. Don't use survey to get total values or where incompleteness of data may distort results.

1959 electrical-systems design survey:

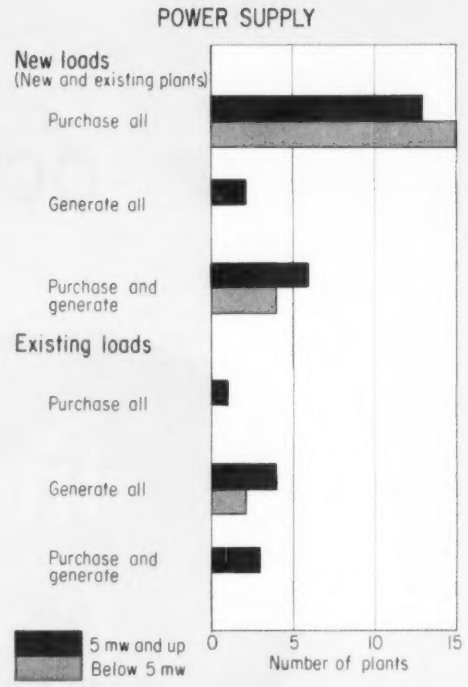
DISTRIBUTION TRENDS

- **More industrials own their main subs**
- **80% of main subs ground neutral**
- **Cable and conduit holds its own**
- **Centralized motor control takes lead**

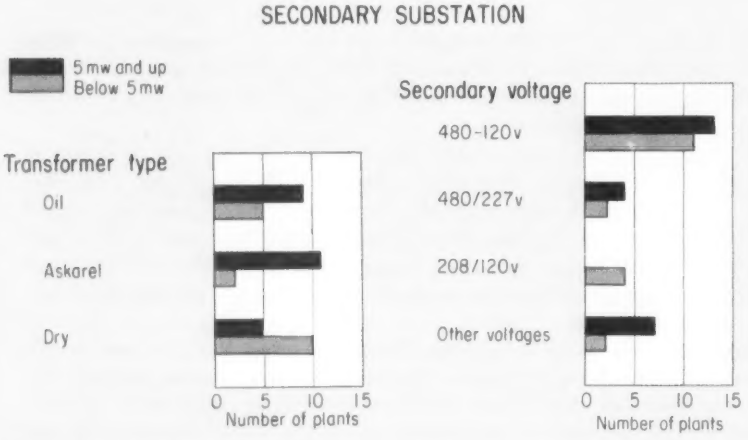
Design features of the electrical-distribution systems in the 44 plants surveyed are summarized on these pages. Tabulation of pertinent data begins on following pages. Although but a relatively small sampling is represented here, it may be considered typical of current practice.

Data in the summaries are divided into two groups, based on plant's electrical size; five mw is the dividing line. Hence the double bar charts. Example: self ownership of main (primary) substation is nearly twice as frequent among plants of five mw or more as among plants of less than five mw. Size of plant usually has influence.

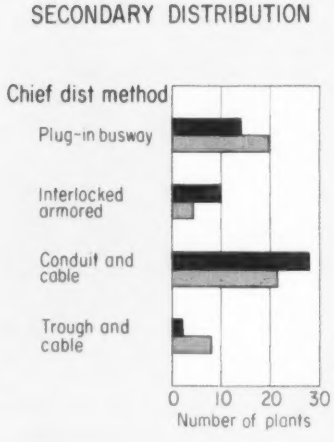
When interpreting trends from these summaries, check into tables for influencing factors. Number of plants generating electricity as shown by the bar charts, for example, doesn't by itself indicate the magnitude of the generator-fed load. Likewise, nature of the manufacturing process would be a consideration. Comparison with last year's summaries will also help you to interpret trends in electrical-distribution system design.



PURCHASED POWER for new loads continues to gain. Some plants which purchase and generate include emergency standby capacity



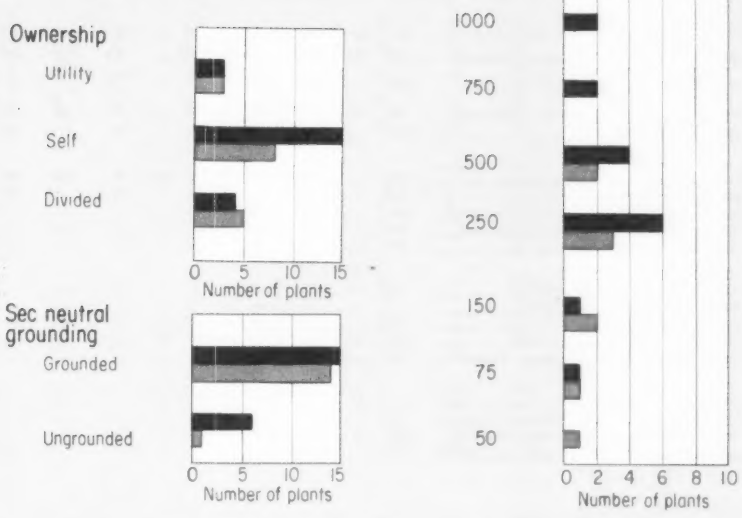
ASKAREL LEADS oil in larger plant transformers, while dry type is out in front in the smaller plants. "Other voltages" include 2400 and 550 volts for majority of load



CABLE IN CONDUIT maintains its lead but plug-in busway is a big challenger

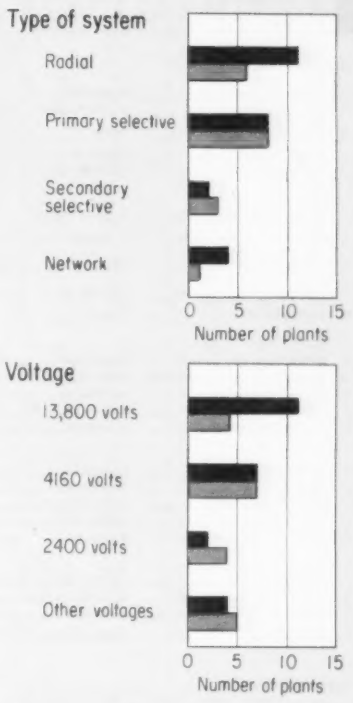
typical industrial plants, institutions

PRIMARY SUBSTATION



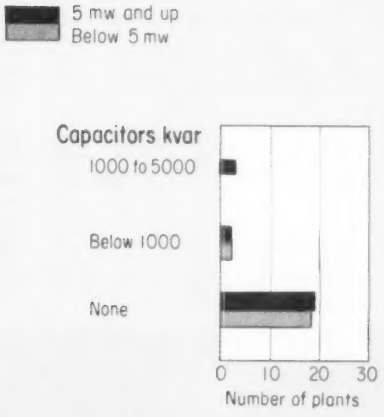
SELF OWNERSHIP of primary substations has clear lead in plants over five mw. Neutral grounding is practiced in four out of five plants; some large plants stay with ungrounded

PRIMARY DISTRIBUTION



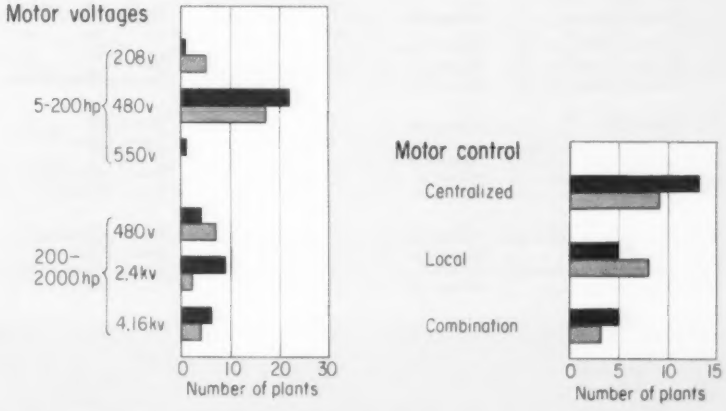
PRIMARY SELECTIVE systems show gain in smaller plants, networks in the larger

POWER-FACTOR CORRECTION



CAPACITORS are not widely adopted; proportion stays about same as last survey

UTILIZATION



MOTOR VOLTAGE to 200 hp is predominantly 480 volts; 550 volts is nearly out of the picture. Centralized motor control shows a definite gain over local in most of plants

Design features of 44 typical electrical

Each listing covers 3 pages. Project number helps you track a specific installation after you turn facing page

Project Number	Company	Location	Electric Utility	Consulting Engineers	Date of initial operation	Plant area, acres	Total plant capacity, mw	EXISTING PLANT: TOTAL OLD LOAD Max Mw	TOTAL OLD LOAD Avg PF	Self generated, mw	Utility supplied, mw	VOLTAGES: Utility supply, kv	Distribution, kv	Utilization, v
PLANTS OVER 5 MW														
1	Dow Chemical Company	Freeport, Texas	Houston L. & P. Co.	Bechtel Corp	.....	.....	810[1]	620	.85	595	25	132	15,2.4	15
2	Armco Steel Corp.	Ashland, Kentucky	Kentucky Power Co.	United Engrs. & Constructors	.....	.....	60	....[4]	.....	.....	.....	.....	.....	.....
3	A. E. Staley Mfg. Co	Decatur, Ill.	Illinois Power Co.	Burns & McDonnell	1959	420	41.5	24	.82	10	14	34.5	13.8,2.3	480
4	Western Electric Co. Inc.	Chicago, Ill.	None	United Engineering Construct	1-59	.....	40[5]	....[5]	.....	.....	.....	.....	.....	.....
5	Chesapeake Corp of Va.	West Point, Va.	.....	Albert C. Wood Associates	7-59	.....	32.5	20	.95	20	.....	None	.....	2400
6	Convair Div. Gen. Dynamics Corp.	Ft. Worth, Texas	Texas Elec. Service Co.	Yandell, Cowan and Love	1958	607	25.6	....[6]	.....	.5[7]	.....	60	4.16	440
7	National Lead Co., Titanium Div.	St. Louis, Mo.	Union Electric Co.	United Engrs. & Constructors	6-59	76.9	24.88	12.73	.82	10.33	.....	4.16	4.16, .480	480
8	Marathon Southern Corp.	Naheolm, Ala.	Alabama Power Co.	J. E. Sirrine Co	12-58	.....	20.25	None	.....	.....	.....	.....	.....	.....
9	National Lead Co., Titanium Div.	Corondelet, Mo.	Union Electric Co.	United Engrs. & Constructors	4-59	.....	19.25	....[8]	.....	.....	.....	34	4.16, .480	480
10	Esso Standard Oil	Bayonne, N. J.	Public Service E. & G. Co.	.....	1960	.....	18.5[9]	9.7	88	0	.....	26	4.16	440
11	Georgia-Pacific Paper Company	Toledo, Oregon	Central Lincoln Peoples Util.	Stone & Webster Eng. Corp.	6-60	.....	17.74	9.24	.90	0	9.24	67	13.8	2400
12	Chrysler Corp., Ohio Stamping Plant	Twinsburg, Ohio	Ohio Edison Co.	.....	9-58	34	17	8.5	.85	.....	.....	132	.....	480
13	U.S. Steel Corp.	Homestead, Pa.	Duquesne Light Company	United Engrs. & Constructors	1960	.....	15	.....[12]	.....	.....	.....	.....	.....	.....
14	Social Security Bldg, U.S. Govt.	Baltimore County, Md.	Baltimore G.& E.Co.	Whitman, Requardt & Assoc	2-60	81	10.5	None	.....	.....	.....	.....	.....	.....
15	Chrysler Corporation	St. Louis, Mo.	Union Electric Co.	Albert Kahn, Inc.	9-59	.....	10	None	.....	.....	.....	.....	.....	.....
16	Pittsburgh Plate Glass	Shelby, N.C.	Duke Power Co.	Lockwood Greene	8-59	133	....[13]	.....	.....	.....	.....	.....	.....	.....
17	Ford Motor Co.	Sandusky, Ohio	Ohio Edison Co.	Giffels & Vallet	.....	.....	9	None	.....	.....	.....	.....	.....	.....
18	California Oil Company	Perth Amboy, N. J.	Public Service E. & G. Co.	.....	3-57	.....	8.4	2.45	.85	4.85	.....	2.4	.....	440
19	Diamond Gardner Corp.	Lockland, Ohio	Cincinnati G. & E. Co.	Fosdick & Hilmer	1958	40	8	7	.90	3.5	3.5	.....	.....	.....
20	University of Wisconsin	Madison, Wis.	Madison G. & E. Co.	Boddy, Benjamin & Woodhouse	9-59	.....	8	.....	.....	.....	.....	.....	.....	.....
21	Alpha Cement Co.	Lime Kiln, Md.	Potomac Edison Co.	.....	.....	50	7.5	.....	.....	.....	.....	.....	.....	.....
22	Corpus Christi Municipal Airport	Corpus Christi, Texas	Central P. & L. Co.	C. E. Dudley	1-61	.....	.7	None	.....	.....	....[1]	.....	.....	.....
23	Western Electric Co., Inc.	Grandview, Mo.	Kansas City P. & L. Co.	United Engrs. & Constructors	1959	25	6	None	.....	.....	.....	.....	.....	.....
24	U.S. Post Office	Omaha, Nebraska	Omaha Pub. Power Dist.	Henningson, Durham & Richardson	3-60	.....	5.57	.....	.....	.....	.....	.....	.....	.....
PLANTS OF LESS THAN 5 MW														
25	Pittsburgh Plate Glass	Crestline, Ohio	Ohio Edison Co.	Kellam & Foley	8-59	47.5	4.68	.....	.....	.....	.....	.....	.....	.....
26	American Cyanamid	Bridgeville, Pa.	West Penn Power Co.	Scientific Design	8-59	.....	4.65	3.75	.94	0	.....	25	2.3	440/220
27	Southern Pine Lumber Co.	Pineland, Texas	.....	Nelson Miner & Co.	1958	.....	4.5	.....	.....	.....	.....	.....	.....	.....
28	Westinghouse Electric Corp.	Athens, Ga.	Georgia Power Co.	Lockwood Greene Engrs. Inc.	10-58	15.5	4	.....	.....	.....	.....	.....	.....	.....
29	Roy O Martin Lumber Co.	Alexandria, La.	.....	Nelson Miner & Co.	1959	.....	3	None	.....	.....	.....	.....	.....	.....
30	I.B.M. Supplies Div.	Dayton, N. J.	Public Service E. & G. Co.	.....	.....	86	2.5[18]	None	.....	.....	.....	.....	.....	.....
31	Revere Copper & Brass, Inc.	Clinton, Illinois	Illinois Power Co.	.....	5-58	.....	2.25	None	.....	.....	.....	.....	.....	.....
32	Kalamazoo State Hospital	Kalamazoo, Mich.	Consumers Power Co.	Cummins & Barnard, Inc.	11-58	.....	2.15	.95	.87	.95	.....	.....	2.4	480
33	Sylvania Elec. Products, Inc.	Altoona, Pa.	Pennsylvania Electric Co.	.....	8-58	4.5	2	None	.....	.....	.....	.....	.....	.....
34	Westinghouse Electric Corp.	Youngwood, Pa.	West Penn Power Co.	Austin Co.	3-59	3.7	1.85	None	.....	.....	.....	.....	.....	.....
35	Papillion Creek Sewage Treat. Plant	Omaha, Nebraska	Omaha Public Power Dist.	Henningson, Durham & Richardson	1-60	4	1.8	.....	.....	.....	.....	.....	.....	.....
36	General Electric Co.	Cleveland, Ohio	Cleveland Elec. Illum. Co.	Giffels & Vallet	12-57	.....	1.8	None	.....	.....	.....	.....	.....	.....
37	Univ. Medical Center, U. of Mich.	Ann Arbor, Mich.	Detroit Edison Co.[29]	Cummins & Barnard, Inc.	6-59	3	1.5[30]	1.5	.90	1.5	0	2.4[29]	.120	120
38	County-City Building	Tacoma, Washington	Tacoma City Light Co.	W. S. Gordon	4-59	.....	1.5	None	.....	.....	.....	.....	.....	.....
39	U.S. Appraisers Stores	Baltimore, Md.	Baltimore G.& E. Co.	Whitman, Requardt & Assoc	6-59	.....	1.3	.19	.85	.....	.....	208/120	.....	208/120
40	Baltimore City Jail	Baltimore, Md.	Baltimore G. & E. Co.	Whitman, Requardt & Assoc.	1960	.....	1.2	.....	.....	.....	.....	.....	.....	.....
41	Janitrol Aircraft Div., Surf.Comb. Corp.	Columbus, Ohio	Columbus & South. Ohio E. Co	H. A. Williams & Associates	6-58	3.2	1.2	None	.....	.....	.....	.....	.....	.....
42	Pittsburgh Plate Glass	Decatur, Illinois	Illinois Power Co.	Sverdrup & Parcel	4-59	80	1	.....	.....	.....	.....	.....	.....	.....
43	Safety Patrol Bldg., State Penitentiary	Lincoln, Neb.	Penitentiary Power Plant	Henningson, Durham & Richardson	2-59	1	.675	None	.....	.....	.....	.....	.....	.....
44	Southern Laces	Wilmington, N.C.	Carolina Power Co.	.....	1959	11	.6	.....	.....	.....	.....	.....	.....	.....

1 - Includes 3 new generators
2 - 440 v to 100 hp, 2400 v above
3 - Data which follows applies to whole distribution system
4 - No data
5 - Not broken down as to new and old load
6 - No breakdown of old and new load
7 - Emergency only
8 - No data
9 - Based on .88 pf
10 - 480 v to 125 hp, 2400 v above
11 - On one trans. one being added
12 - No data
13 - Not yet established
14 - One spare
15 - To 600 hp
16 - 4500 amps on 13.2 kv
17 - 1200 amps
18 - mva
19 - 2 in 3; 1 in 1
20 - 3 single-phase in bank
21 - Switchgear only in substation
22 - 1200 amperes
23 - 5.5 (3750 kva), 6.08/12.2&6.2 (4000 kva), 6.57 (2500 kva)
24 - At 13.8 kv level
25 - At utility substation
26 - At 2.4 kv
27 - 10,900 amperes
28 - 220 v to 100 hp, 4160 v above
29 - Power supplied by University power plant. Emergency tie with Detroit Edison
30 - New load not specified. Total capacity of generators is 7.55 mw
31 - 240 v for fluorescent lights
32 - Main lighting: 100,000 amps; main power: 75,000 amps
33 - 52,000 amperes

distribution systems, new and modernized

GENERATION (NEW LOAD)					UTILITY SUPPLIED NEW LOAD			PLANT VOLTAGES						PRIMARY SUBSTATION							
	NEW UNITS									MOTOR VOLTAGE, V				TRANSFORMERS							
Total generating capacity, mw	Voltage, kv	Mw	PF	Manufacturer	Max Mw	Avg PF	Kv	Distribution, kv	Utilization, v	5-200 hp	201-2000 hp	2001 hp-upward	277-v lights	Number of subs	Number each sub	Manufacturer	Impedance, %	Secondary neutral grounded	Circuit breaker 3-ph interrupting mva	Available s-c, mva	Project Number
150[1]	14.4	50,50,50[1]	.85	GE	40	1.00	132	14.4	2400	480[2]	2400[2]	.....	No	2[3]	4,5	WE	.....	Yes	750	750	1
0	.....	.....	.....	.....	60	.....	.....	6.9	440	440	.....	6900	No	1	3	WE	.....	No	1000	.....	2
24	13.8	7.5	.8	WE	10	.90	34.5	13.8,2.3, .48	480	480	480, 2300	.....	No	1	6	GE	5.6	No	250	188	3
.....	12.5	.....	.....	GE	.....	.....	.....	12.5	4.16	440	4160	.....	Yes	1	2	GE	6.75	.....	75	70	4
.....	13.2	12.5	.8	WE	None	.....	.....	2.4	2400	600	2400	2400	No	1	2	WE	5.5	No	500	160	5
.....	.....	.....	.....	.....	.....[6]	1.0	60	4.16	440	440	4160	.....	Yes	1	1	P	8.3	Yes	250	102.5	6
5	4.16	5	.80	GE	7.15	.82	4.16	4.16	480	480	4160, 480	.....	No	1	2	GE,ACC	.....	Yes	250	250	7
18.75	13.8	18.75	.85	GE	1.5	.....	13.8	13.8	440, 2300	440	2300	.....	Yes	1	3	.....	.....	Yes	500	.....	8
15	4.16	5	.80	GE	4.25	.85	34	4.16	480	480	4160	.....	No	1	2	.....	5.5	No	250	.....	9
0	.....	.....	.....	.....	.....	.....	26	4.16	440	440	4160	.....	Yes	2	2,3	Mo,WE	5.56	Yes	150	100	10
0	.....	.....	.....	.....	8.5	.90	67	13.8	2400	480[10]	2400[10]	.....	No	1	1	.....	7.9	Yes	500	500	11
0	.....	.....	.....	.....	8.5	.85	132	13.2	480	480	2300	.....	.....	1	3	GE	8	Yes	500	173	12
.....	.....	.....	.....	.....	15	.85	69	69	13,800	440	2300	13,800	Yes	2	1	WE	8.5	Yes	750	300	13
0	.....	.....	.....	.....	10.5	.85	33	13.8	480/277	480	2400	.....	Yes	1	2	WE	7	Yes	250	175	14
0	.....	.....	.....	.....	10	.....	.....	12.47	480	480	0	0	No	1	2	.....	.....	.....	.....	.....	15
0	.....	.....	.....	.....	.....[13]	.....	13.2	13.2	480/277	440	440	.....	No	1	4[14]	WE	.....	Yes	1500	.....	16
0	.....	.....	.....	.....	9	.91	138	13.8	440	440	13,800	.....	No	1	2	ACC	.....	Yes	.....	500	17
0	.....	.....	.....	.....	5.95	.85	26.4	13.8,2.4	440	440	2400	.....	No	1	3	P	6	Yes	1000	1000	18
0	.....	.....	.....	.....	1	.9	13.2	4.16	480	480	480[15]	.....	Yes	1	2	GE	5.89	Yes	125	.....[16]	19
3.15[7]	.....	3.15	.8	GE	8	.....	4.16	4.16	440	440	.....	.....	No	1	1	WE	.....	No	250	.....	20
0	.....	.....	.....	.....	7.5	1.0	33	4.16	4160	440	4160	.....	No	1	1	ACC	6	Yes	.....[17]	.....	21
0	.....	.....	.....	.....	.7	.....	2.3	2.3	230	230	.....	.....	No	2	3	Up	.....	No	25	15	22
0	.....	.....	.....	.....	.....	.....	12	480/.277	480/277	440	.....	4160	Yes	4	.....[19]	ACC	.....	Yes	.....	.....	23
.....	.....	.....	.....	.....	5.57	.90	480/.277	480/.277	480/277, 120	480	.....	.....	Yes	.....	.....	.....	.....	.....	.....	.....	24
0	.....	.....	.....	.....	4.68	.85	69	13.8	480/277	440	440	.....	Yes	1	1	P	7.5	Yes	500	130	25
0	.....	.....	.....	.....	.9	.90	25	25	480	440	.....	.....	No	1	2	.....	5	No	50	40	26
4	4.16/2.4	4	.7	WE	.5	.8	4.16	4.16/2.4	440	440	2400	.....	No	.....	.....	.....	.....	.....	.....	.....	27
0	.....	.....	.....	.....	4	.99	44	4.16	.....	480	4160	.....	No	1	2	WE	6.7	Yes	.....	.....	28
2	2.4	2	.8	WE	1	.8	2.4	2.4, .44	440	440, 2400	2400	.....	No	1	1[20]	ES	.....	Yes	.....	.....	29
0	.....	.....	.....	.....	2.5[18]	.....	.....	4.16	208	208	480	.....	No	.....[21]	.....	.....	.....	Yes	75	.....[22]	30
0	.....	.....	.....	.....	2.25	1.00	4.16	4.16, .480	480, 4160	480	4160	.....	Yes	1	3	GE	3.8	Yes	.....	.....	31
1	.....	.....	.....	.....	1.2	.90	13.8	13.8,2.4	480	480	480	.....	No	3	1	WE,GE	23	24	150[26] 500[24]	300[26] 400[24]	32
0	.....	.....	.....	.....	2	.90	4.16	4.16	480	208,480	480 4160	.....	Yes	1	3	WE	7.8	Yes	250	.....[27]	33
0	.....	.....	.....	.....	1.85	.88	25	4.16	208/120	220[28]	4160[28]	.....	No	1	2	WE	6.5	Yes	150	100	34
.....	.....	.....	.....	.....	1.8	.....	2.4, .480	2.4, .480	480	480	.....	.....	No	.....	.....	.....	.....	.....	.....	.....	35
0	.....	.....	.....	.....	1.8	.76	36	2.4	480	480	.....	.....	Yes	1	3	GE	.....	Yes	150	.....	36
.....[30]	.....	.....	.....	.....	0	.....	.....	.208/.120	120	208	.....	.....	No	0	.....	.....	.....	.....	.....	.....	37
.15[7]	416/240	.15	.80	...	1.5	.....	4.16	4.16	416/240	416	.....	.....	.....[31]	1	6	LM	.....	Yes	.....[32]	.....[33]	38
.....	.....	.....	.....	.....	1.1	.....	.460/.265	.460/.265	460	440	440	.....	No	1	2	WE	5	Yes	.050	.046	39
.....	.....	.....	.....	.....	1.2	.85	13.2	13.2	208/120	208	.....	.....	No	3	2	.....	5	Yes	250	.....	40
0	.....	.....	.....	.....	1.2	.9	13.2	.440	440	440	440	.....	Yes	3	1	GE	.....	Yes	.....	250	41
0	.....	.....	.....	.....	1	.85	34.5	13.8	480/277	440	440	.....	No	1	2	W	5.5	Yes	250	.....	42
0	.....	.....	.....	.....	.675	.....	2.4	2.4	208/120	208	.....	.....	No	0	.....	.....	.....	.....	.....	.....	43
0	.....	.....	.....	.....	.6	.85	.480	.480	440	440	.....	.....	.....	1	3	ACC	4.6	Yes	.....	.....[34]	44

34 - 215,000 amperes

AB - Allen-Bradley Co
ACC - Allis-Chalmers Mfg Co
AWC - Anaconda Wire & Cable Co
BE - Bulldog Electric Products Co
C - Clark Controller Co
CH - Cutler-Hammer, Inc
CWC - Crescent Insulated Wire & Cable Co
EC - The Elliot Co
ES - The Electric Service Co, Inc
FP - Federal Pacific Electric Co
GC - General Cable Co
GE - General Electric Co
ITE - I-T-E Circuit Breaker Co
J - Jefferson Electric Co
LA - The Louis-Allis Co
LM - Line Material Co
ME - Marathon Electric Co
Mo - Moloney Electric Co
Ok - The Okonite Co
P - Pennsylvania Transformer Co
PD - Phelps Dodge Copper Products Corp
PE - Penn Electrical Company
Re - Rockbestos Products Corp
RS - J. A. Roebling's Sons Corp
SC - S & C Electric Co
SD - Square D Co
SE - Sprague Electric Co
So - Sorgel Electric Co
T - Trumbull Components Dept, General Electric Co
Up - R. E. Uptegraff Mfg Co, Inc
W - Wagner Electric Corp
WE - Westinghouse Electric Corp

Electrical design features continued

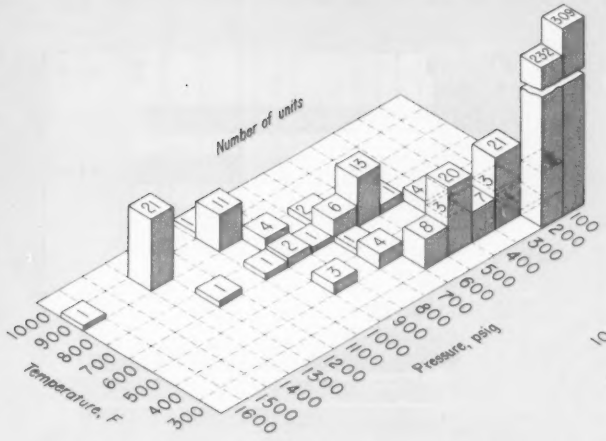
Compiled by:
Norman Peach, Associate Editor

Project Number	PRIMARY SUBSTATION (Cont.)			PRIMARY DISTRIBUTION (ABOVE 600v)				SECONDARY SUBSTATIONS					SECONDARY DISTRIBUTION			UTILIZATION											
																TOTAL LOAD DIVISION							MOTOR CONTROL				
	Switchgear Manufacturer	Ultimate sub capacity, mva	Ownership	Circuitry	Overhead or underground	Distribution means	Cable mfr	Number	Unit sub mfr	Transformer type	Manufacturer	Secondary neutral grounded	Means	Busway manufacturer	Cable manufacturer	Lighting, %	Motors, %	Welding, % (Supply capacity)	Heat and process, %	Dc, %	Total motor hp	Motor mfr(s)	Centralized or local	Control mfr(s)	Capacitors, kvar	Capacitor manufacturer	Lighting type
1	WE	176	S	Ra,Ne	Ov	AC	Var	16	GE,WE	Oil	GE,WE	No	.....[35]	.....	.....	.....	25[36]	75	.....	.....	150,000	Var	Both	Var	0	.....	F,I,M
2	WE	60	S	Ra	Ov	AC	.....	.....	.....	Oil	.....	No	CC	.....	.....	10	90	.....	.....	.....	.....	.....	Cen	.....	.....	.....	F,I,M
3	GE	20	S	Ne	.....	.....	.....	30	GE,W, WE,ACC	Air	.....	No	CC	.....	Var	3	97	.....	.....	.....	50,000	Var	Both	.....	7600	GE	F,I,M
4	GE	4	S	PS	.....	.....	.....	.....	.....	Dry	.....	.....	PB,IA	.....	.....	15	30	30	25	.....	.....	Var	Cen	.....	.....	.....	F,M
5	WE	12.5	S	Ra,PS	Ov	AC	.....	1	WE	Dry	WE	No	CC,TC	.....	.....	4	96	.....	.....	.....	8,000	GE,WE	Both	GE,WE	0	.....	F,I
6	FP	12.5	S	Ra	Ov	IA	GE	42	.....	Dry	WE	Yes	PB	SD	.....	40[37]	42.5	10	7	0.5	19,000	GE	Loc	GE,AB	8500[38]	GE	F,I,M
7	ITE	20	D[39]	PS	Ov	AC	AWC	4	ITE	Ask	.....	No	CC	.....	AWC	10	90	.....	.....	.....	3,960	Var	Cen	GE	.....	.....	F,I
8	GE	2.88	U	Ra	Ov	IA	GE	29	GE	Oil,Ask[49]	GE	Yes	IA	.....	GE	4	96	.....	.....	.....	33,000	ME	Cen	GE	0	.....	F,I,M
9	ITE	10	D	Ra	Ov	AC	AWC	10	ITE	Ask	.....	No	IA,CC	.....	GC,AWC	10	90	.....	.....	.....	.....	.....	Cen	WE,GE	.....	.....	I
10	ITE,WE	15	S	PS	Ov	AC	AWC	10	GE	Ask	GE,WE	Yes	CC	.....	.....	10	80	10	.....	.....	16,000	Var	Cen	Var	0	.....	F,M
11	.....	20	U	Ra	.....	CC	.....	9	.....	Oil	.....	Yes	CC	.....	.....	.....	.....	.....	.....	.....	.....	.....	Cen	.....	0	.....	.....
12	ACC	37.5	S	PS	Un	CC	.....	21	ACC,GE	Ask	ACC,GE	Yes[41]	PB	GE	.....	25	60	.....	15	.....	18,000	Var	Both	SD,GE	4500	SE,GE	F,M
13	WE	50	S	Na	Ov	AC	.....	4	WE	Oil	WE	Yes	CC	.....	.....	10	90	.....	.....	.....	.....	.....	Cen	.....	.....	.....	.....
14	WE	40	S	Ra,SS	Un	CC	RS	5	WE	Ask	WE	Yes	.....[42]	WE	.....	45	50	5	.....	.....	6,500	Var	Cen	Var	.....	.....	F,I,M
15	WE	20	U	PS	Ov	IA	Ok	9	WE	Ask	WE	No	PB	BE	Ok	10	20	20	25	.....	5,800	ACC,LA	Cen	AB,C	500	.....	F
16	WE	16	D	PS	Un	CC	AWC	10	WE	Dry	WE	Yes	IA	.....	Ro	20	40	40	.....	.....	.....	.....	Cen	WE	.....	.....	F
17	ITE	40	S	SS	Un	.....	.....	6[43]	ITE	Oil	ITE	No	PB,IA	FP	.....	.....	.....	60	2	10	.....	Var	Loc	Var	.....	.....	.....[44]
18	GE,FP	14.25	S	Ne	Ov	AC	.....	15	Var	Oil	.....	Yes	CC	.....	.....	5	95	.....	.....	.....	.....	Var	.....	.....	900	GE	F,I,M
19	GE	5.25	S	Ra	Ov	IA	GE,AWC	.....	GE	Ask	GE	Yes	.....	.....	.....	10	90	.....	.....	.....	10,000	Var	Both	Var	0	.....	F,I,M
20	WE	7.5	D	Ra	Ov	CC	.....	1	GE	Ask	.....	No	CC	.....	.....	.....	.....	.....	.....	.....	.....	.....	Loc	.....	.....	.....	I
21	ACC	7.5	S	.....	.....	IA	GE	11	ACC	Ask	ACC	.....	CC	.....	.....	.....	.....	.....	.....	.....	.....	.....	Cen	ACC	.....	.....	F,I,M
22	GE	.75	.....[45]	Ra	Un	CC	Var	.....	.....	.....	.....	.....	CC	.....	.....	70	30	.....	.....	.....	.....	.....	Loc	.....	.....	.....	F
23	ACC	1.5	S	PS	Ov	CC	.....	None	.....	.....	.....	.....	PB,CC	.....	.....	10	40	50	.....	.....	.....	.....	Loc	.....	.....	.....	F
24	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	PB,CC	GE	.....	55	45	.....	.....	.....	.....	.....	Cen	GE	.....	.....	F,I
PLANTS OF LESS THAN 5 MV																											
25	ITE	9.4	S	PS	Ov	AC	Ok	4	ITE	Dry	ITE	Yes	IA	.....	Ro	20	30	50	.....	.....	2,250	Var	Cen	.....	.....	.....	F
26	.....	.75	S	Ra	Ov	AC	.....	None	.....	.....	.....	.....	CC	.....	.....	24	70	5	1	.....	.....	.....	Cen	SD	0	.....	F,I
27	.....	.....	.....	PS	Ov	.....	.....	4	GE,ES	Oil,Ask	GE,ES	Yes	PB,CC,TC	.....	.....	10	90	.....	.....	.....	10,000	Var	Loc	.....	.....	.....	F,I
28	WE	7.5	D[46]	PS,SS	Ov	IA	AWC	11	WE	Dry	WE	Yes	PB	WE	.....	12	45	17	26	.....	5,336	WE	Loc	WE	0	.....	F,M
29	GE,ACC	.....	S	PS	Ov	.....	.....	3	.....	Oil	ES	Yes	PB,CC,TC	.....	.....	10	90	.....	.....	.....	4,000	Var	Both	Var	.....	.....	F,I
30	ACC	.....	S[47]	Ra	Ov	CC	PD	7	WE	Dry	WE	Yes	PB,CC	SD	PD,GC	35	60	5	.....	.....	840	WE	Loc	CH	.....	.....	F
31	SC	3	U	PS,SS	Un	CC	GC	2	GE	Oil	GE	.....	PB,CC,TC	T	GC	12	76	12	.....	.....	.....	Var	Both	Var	300	GE	F,I
32	GE	9,6.25,5	D	Ra	Un	CC	GC	None	.....	.....	.....	.....	CC	.....	CWC	5	95	.....	.....	.....	.....	Var	Cen	CH	.....	.....	F,I,M
33	.....	7.5	D[48]	Ra	.....	IA	GE	.....	WE	Dry	WE	Yes	PB,IA	BE	GE	28	32	35	2	3	2,000	ACC,GE, WE	Cen	SD	260	SE	F
34	WE	4	S	Ne	.....	IA	.....	4	WE	Dry	WE	Yes	PB	WE	.....	25	50	25	.....	.....	1,000	WE	Loc	.....	.....	.....	F,M
35	.....	.....	.....	.....	.....	.....	.....	2	WE	Dry	WE	Yes	CC	.....	AWC	20	80	.....	.....	.....	.....	.....	Cen	WE	.....	.....	.....
36	GE	3.75	D[49]	SS	Un	CC	GE	.....	GE	Ask	GE	Yes	BB,IA	GE	GE	25	35	40	.....	.....	650	GE	Loc	GE	0	.....	F
37	.....	.....	.....	Ra	.....	CC	Ok	6	So,WE	Dry	So,WE	Yes	CC	.....	GC	80	20	.....	.....	.....	.....	Var	Loc	.....	.....	.....	I
38	SD	3	S	Ra	Un	CC	.....	70	.....	Dry	J	Yes	CC	.....	.....	60	40	.....	.....	.....	1,625	.....	Both	SD	.....	.....	F,I,M
39	.....	1200	U	.....	.....	.....	.....	1	GE	Dry	GE	Yes	PB	BU	.....	20	80	.....	.....	.....	.....	.....	Cen	CH	.....	.....	F,I
40	.....	1.0	S	PS[50]	Un	CC	.....	.....	.....	.....	.....	.....	CC	.....	.....	57	33	10	.....	.....	.....	.....	Cen	PE	.....	.....	F,I
41	GE	1,1,.5	S	PS	Un	CC	GE	10	GE	Dry	GE	Yes	PB	BE	.....	64	10	10	16	0	1,288	Var	Loc	Var	0	0	F,I
42	GE	7.5	D	PS	Un	CC	Ok	1	ITE	Oil	P	Yes	IA	.....	Ro	20	40	40	.....	.....	1,460	WE	Cen	CH	.....	.....	F,M,I
43	.....	.....	.....	.....	.....	.....	.....	1	GE	Oil	.....	.....	CC	.....	.....	80	20	.....	.....	.....	.....	.....	Cen	SD	.....	.....	F,I
44	.....	1	U	.....	.....	.....	.....	.....	.....	.....	.....	.....	PB,CC,TC	.....	.....	15	85	.....	.....	.....	.....	.....	Loc	.....	.....	.....	F,I

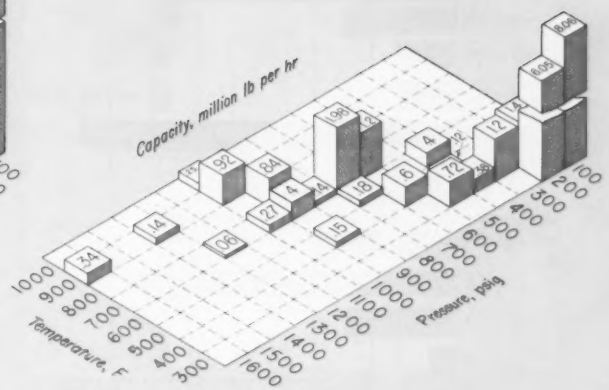
For key to manufacturers see preceding pages

35 - Open wire
36 - Includes lighting
37 - All utilization figures include old plant
38 - Owned by utility
39 - Utility owns transformers and primary switchgear
40 - One oil, 28 askarel
41 - Not on in-line production equipment
42 - Distribution busway
43 - With 15 transformers
44 - 80% M, 15% F, 5% I
45 - Utility owns one, plant owns the other
46 - Secondary switchgear is self-owned
47 - Switchgear only in substation
48 - 4.16-kv switchgear is self owned
49 - Utility owns transformer and superstructure
50 - Secondary selective features
AC - Aerial cable
Ask - Askarel
CC - Cable in conduit
Can - Central
D - Divided ownership
F - Fluorescent
I - Incandescent
IA - Interlocked armored cable
Loc - Local control
M - Mercury-vapor
Ne - Network
Ov - Overhead
PB - Plug-in busway
PS - Primary selective
Ra - Radial
S - Self ownership
SS - Secondary selective
TC - Trough & Cable
U - Utility ownership
Un - Underground
Var - Various

TODAY'S STEAM CONDITIONS

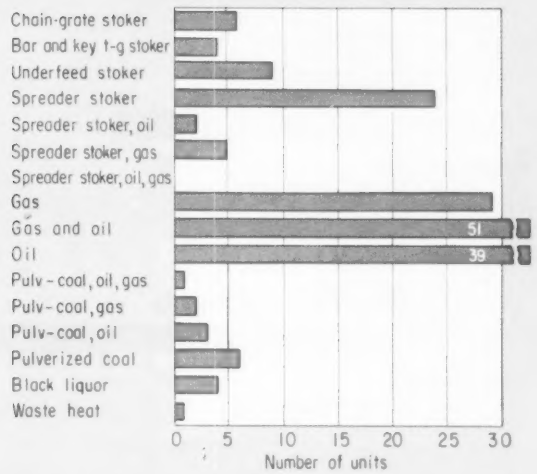


TOTAL REPORTED SALES of boilers for the year ending April 1, 1959 are 622 as opposed to 667 for the preceding 16 months



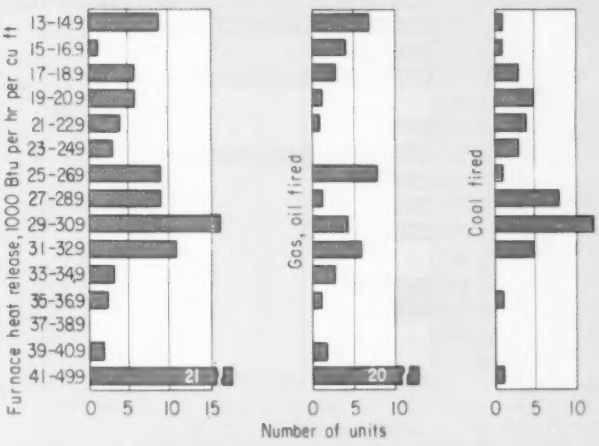
TOTAL CAPACITY is 25,800-M lb per hr representing a decline from the 39,800-M lb per hr reported for the prior 16 months

FIRING METHODS



GAS AND OIL combination burners continued their commanding lead this year. But oil-fired units show a gain over last year

HEAT RELEASE

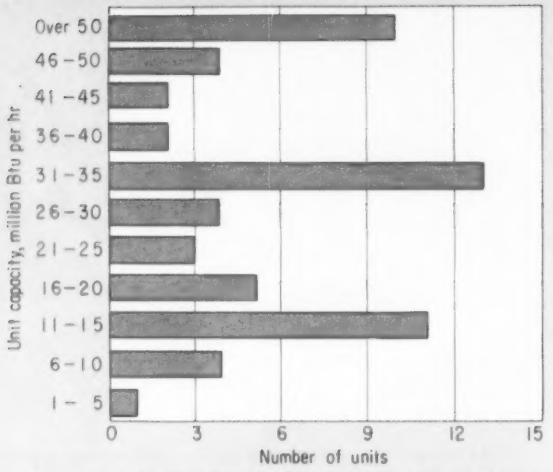


OIL FIRING in the highest heat-release range shows outstanding gains. In the middle heat range coal firing leads again

INDUSTRIAL PLANT: smaller boilers gain

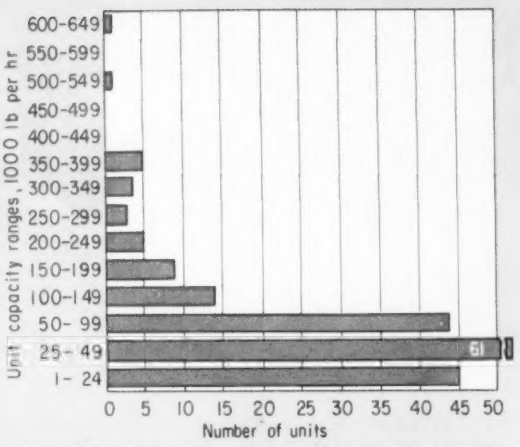
The decline in industrial capacity previously reported has continued this year. Recent upturns in the national economy, however, would indicate that our report next year will show strong growth in this area. More new plants and expansion and modernization of present facilities will be needed to meet tomorrow's increased power requirements

HIGH-TEMPERATURE WATER



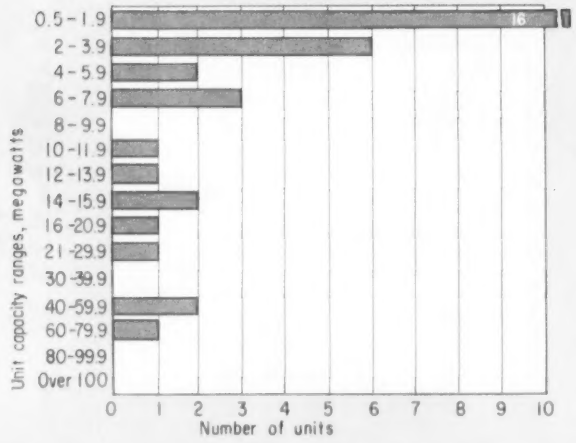
LARGE HIGH-TEMPERATURE-WATER boilers show considerable gain, but there's some reduction in the smaller-sized boilers

BOILER SIZES



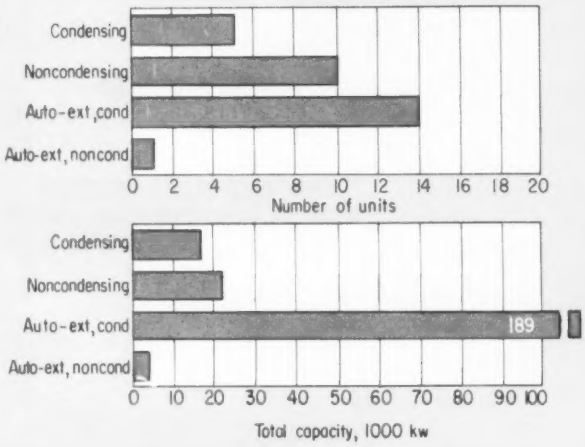
SMALLER BOILER SIZES show considerable gain over the previous year. Larger steam-generator sizes continue their past trends

TURBINE SIZES



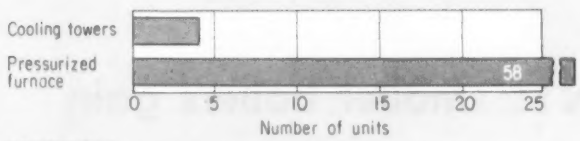
SMALLER TURBINES still lead the group and also show some gains combined with a slight increase in the larger turbines

TURBINE TYPES

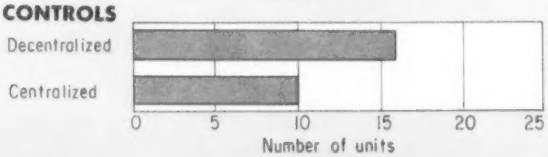


AUTO-EXTRACTION condensing turbines show significant gains. Noncondensing machines have completely dropped from view

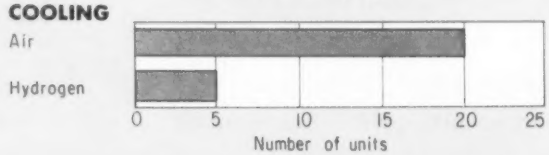
PLANT FEATURES



B-T CONTROLS

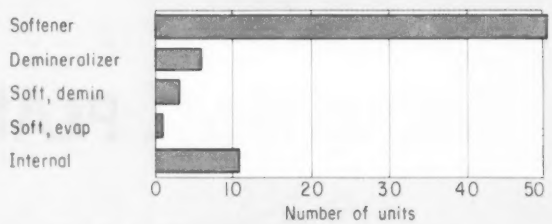


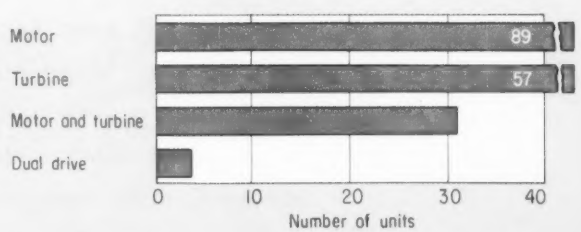
GEN COOLING



DECENTRALIZED CONTROLS and pressurized firing gain some ground over last year. But cooling trends remain unchanged

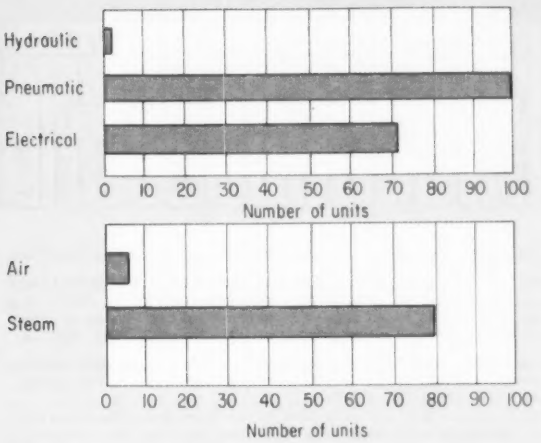
FEED TREATMENT — FEED-PUMP DRIVE





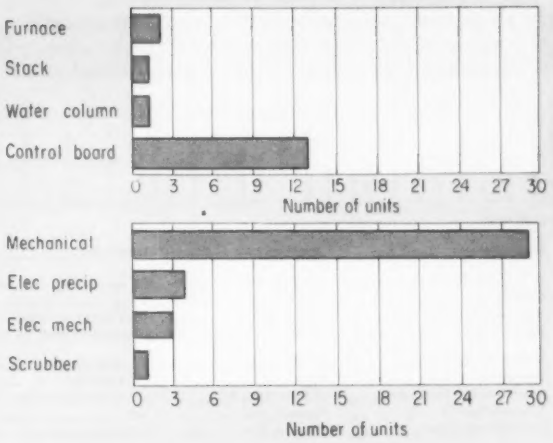
SOFTENERS continue big lead in feedwater-treatment methods. Separate motor-driven boiler-feed pumps gain over last year

COMBUSTION CONTROLS — SOOT BLOWERS



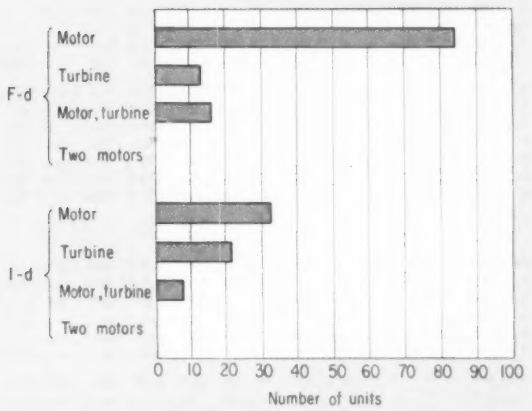
PNEUMATIC COMBUSTION CONTROLS lead electric systems. Steam for soot blowing far exceeds air for industrial duty

TV MONITORS — DUST COLLECTORS



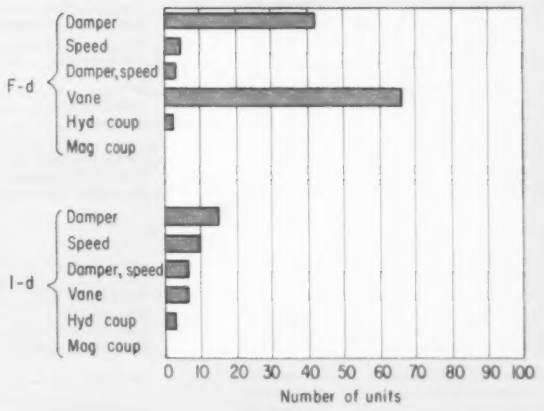
TV MONITORING of control boards is most popular. Mechanical dust-collecting methods strongly lead other arrangements

FAN DRIVES



FORCED-DRAFT FAN installations exceed i-d arrangements. Motor drives are most popular for both the f-d and i-d fans

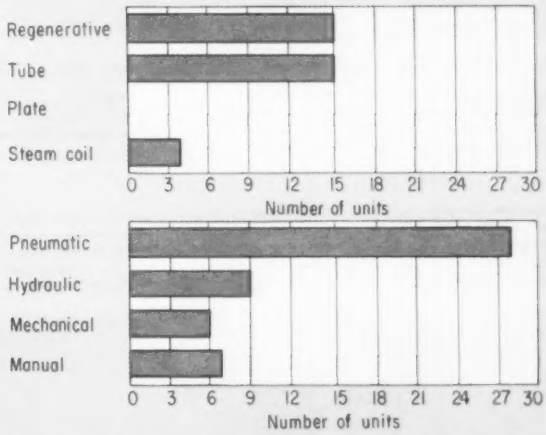
FAN CONTROLS



VANE CONTROL of forced-draft fans is most popular. Damper control of induced-draft fans leads the other control setups

Continuing advances in industrial power-plant design show the need for our including additional comparative data. As a result, this portion of the survey has been expanded to show the relative popularity of combustion-control equipment, TV monitoring, f-d and i-d fans and air heaters

AIR HEATERS — ASH-HANDLING SYSTEMS



REGENERATIVE AND TUBE type air heaters show equal popularity. Pneumatic ash handling leads the other arrangements

1959 design survey: typical industrial,

Note that each listing covers four pages. Project number helps you track a specific installation after turning facing page

Project number	Company	Location	Consulting Engineers	New or existing plant	Date of initial operation	Principal steam use	BOILERS: Number new boilers	BOILERS: Manufacturer	BOILERS: Oper press, psig	BOILERS: Oper temp, F	BOILERS: Boiler type	BOILERS: Capacity each, 1000 lb per hr	SURFACE, 1000 SQ FT: Boiler and waterwalls	SURFACE, 1000 SQ FT: Economizer	SURFACE, 1000 SQ FT: Superheater	SURFACE, 1000 SQ FT: Air heater
2000 TO 601 PSIG																
1	St. Joseph Lead Co	Josephtown, Pa	Kaiser Engrs	New	5-58 8-58	Po	2[1]	CE	1850	1000	WT	375	7.79	19.6	21.8	63.4
2	W. Va. Pulp & Paper Co	Charleston, S C	Self	Ex	10-58	Po	1	CE	1500	880	WT	350	7.04	19.03	9.8	37.3
3	Ketchikan Pulp Co	Ward Cove, Alaska	.....	.....	.....	.....	1	BW	425	825	WT	93	2.09	.....	2.11	37.85
4	United States Steel Corp	Clairton, Pa	United Engrs & Constr Inc	Ex	1960	Po, Pr	1	BW	900	900	WT	500	42	None	12.3	129
5	Western Electric Co, Inc	Chicago, Ill	United Engrs & Constr Inc	Ex	1958	Po, Pr	1	RS	900	835	WT	150	11.4	None	5.4	40
6	Marathon Southern Corp	Naheola, Alabama	J. E. Sirrine Co	New	7-58	Po	1	RS	875	825	WT	300	26.68	4.34	9.0	22.9
7	Marathon Southern Corp	Naheola, Ala	J. E. Sirrine Co	New	7-58	Pr	1	BW	875	825	WT	181	26.25	5.51	9.13	22.0
8	National Lead Co, Titanium Div	St. Louis County, Mo	United Engrs & Constr Inc	Ex	1-59	Po, Pr	1	BW	875	900	WT	125	.....	.....	.....	.....
9	Sutherland Paper Co	Kalamazoo, Mich	Self	Ex	.....	Po, Pr	1	RS	850	825	WT	180	17.81	None	None	21.6
10	Kalamazoo State Hospital	Kalamazoo, Mich	Cummins & Barnard Inc	Ex	1-59	Po, Sh	1	EC	700	825	WT	125	16.0	6.5	3.62	None
11	Richfield Oil Corp	Los Angeles, Cal	C. F. Braun & Co	Ex	10-59	Pr	1	BW	690	750	WT	300	23.48	None	.....	25.6
12	United States Steel Corp	Gary, Indiana	United Engrs & Constr Inc	Ex	7-59	Po	1	BW	675	825	WT	250	32.28	10.78	.....	36.9
13	Roy O. Martin Lumber Co	Alexandria, La	Nelson Miner & Co	.....	1959	Po, Pr	1	BW	650	750	WT	60	.....	.....	.....	.....
14	The Pacific Lumber Co	Scotia, Cal	The Fluor Corp	Ex	9-58	Po, Pr	1[1]	BW	650	750	WT	125	15.0	.....	None	28.2
15	Diamond Gardner Corp	Lockland, Ohio	Fosdick & Hilmer	.....	3-59	Po, Pr	1	RS	625	720	WT	100	14.9	.....	.....	9.6
16	National Petro-Chemicals Corp	Tuscola, Illinois	Stone & Webster Corp	Ex	2-60	Pr	1	CE	625	750	WT	200	9.84	.....	.....	25.5
600 TO 401 PSIG																
17	Freeport Sulfur Co	Grand Isle, La	Sargent & Lundy	New	4-60	Pr	4	RS	600	600	WT	90	10.7	None	0.6	.....
18	Georgia-Pacific Paper Co	Toledo, Oregon	Stone & Webster Engr Corp	Ex	1960	Pr	1	CE	600	660	WT	190	.....	.....	.....	.....
19	H. J. Heinz Co	Pittsburgh, Pa	Peter F. Loftus Corp	Ex	1958	Po, Pr	5	BW	600	750	WT	40	4.6	2.6	1.27	.....
20	University of Wisconsin	Madison, Wis	Boddy Benjamin & Woodhouse	New	9-59	Po, Sh	3[13]	BW	600	725	WT	100	9.23	5.20	.....	None
21	E. I. du Pont de Nemours & Co	Buffalo, N Y	Self	Ex	12-58	Pr	1	RS	550	730	WT	125	16.4	.....	2.9	12.8
22	Toms River-Cincinnati Chemical Co	Toms River, N J	A. M. Kinney, Inc	Ex	7-59	Pr	1	CE	500	650	WT	160	15.1	8.5	.....	None
23	E. I. du Pont de Nemours & Co	Johnsonville, Tenn	Self	New	9-58	Pr	2	RS	475	Sat	WT	90	11.8	1.8	None	None
24	Clinton Corn Processing Co	Clinton, Iowa	Stanley Engineering Co	Ex	8-59	Po, Pr	1	BW	450	550	WT	300	20.4	None	1.7	.....
25	Crossett Paper Corp	Crossett, Arkansas	J. E. Sirrine Co	Ex	.....	Po, Pr	1	CE	450	700	WT	201	28.57	10.1	7.62	13.3
26	Union Bag-Camp Paper Corp	Savannah, Ga	.....	Ex	7-59	Pr	1	CE	450	750	WT	218	41.3	10.8	13.3	14.8
27	Armco Steel Corp	Ashland, Kentucky	United Engrs & Constr Inc	Ex	.....[7]	Pr	1	BW	425	750	WT	165	23	None	.....	36
28	Colgate Palmolive	Jersey City, N J	United Engrs & Constr Inc	Ex	12-58	Po, Pr	1	RS	420	610	WT	85	10.83	3.14	1.42	None
29	Munising Paper Co	Munising, Mich	Power Service Corp	Ex	6-58	Po, Pr	1	BW	410	710	WT	150	16.48	10.68	.....	None
400 TO 251 PSIG																
30	El Paso Natural Gas Co	Gallup, N M	.....	New	12-59	Pr	1	VO	400	Sat	WT	70	8.13	None	None	.....
31	El Paso Natural Gas Co	Jal, New Mexico	.....	Ex	10-59	Pr	1	VO	400	Sat	WT	45	5.14	None	None	None
32	The Hubinger Co	Keokuk, Iowa	Stanley Engineering Co	Ex	1-60	Po, Pr	1	WI	400	750	WT	165	18.6	6.0	0.8	.....
33	Southern Pine Lumber Co	Pineland, Texas	Nelson Miner & Co	Ex	1958	Po, Pr	1	BW	400	600	WT	60	.....	.....	.....	.....
34	Southern Pine Lumber Co	Pineland, Texas	Nelson Miner & Co	Ex	1958	Po, Pr	1	EI	400	600	WT	60	.....	.....	.....	.....
35	University of Wyoming	Laramie, Wyoming	Stanley Engineering Co	Ex	9-60	Sh	1	.....[8]	400	750	WT	50	.....	.....	.....	.....
36	Convair, Div of Gen Dynamics	Ft Worth, Texas	Tippett & Gee	Ex	12-59	Pr	1	BW	275	Sat	WT	150	9.0	None	None	14.3
37	El Paso Natural Gas Co	Jal, New Mexico	.....	Ex	10-59	Pr	1	VO	275	Sat	WT	55	.....	.....	.....	.....
38	Grand Forks Air Base	Grand Forks, N D	Stanley Engineering Co	Ex	10-59	Sh	2	IBW	275	414	WT[12]	42[9]	3.3	None	None	4.1
39	Parke, Davis & Co	Ann Arbor, Mich	Skidmore, Owings & Merrill	New	12-59	Po, Pr, Sh	3	UI	265	510	WT	50	4.36	None	0.20	None
250 TO 201 PSIG																
40	Crosby Lumber Co	Crosby, Miss	Rust Engineering Co	Ex	8-59	Po, Pr	1	GS	250	Sat	WT	90	12.4	None	None	None
41	Lake Placid Club	Lake Placid, N Y	Pode & Evans	Ex	10-59	Po, Sh	1	BW	250	540	WT	30	2.87	.....	.....	.....
42	Phillips Petroleum Co	Borger, Texas	Self	Ex	.....	Pr	2	WI	250	Sat	WT	225	22.0	.....	.....	10.6
43	United States Plywood Corp	Roseburg, Ore	Self	New	3-58	Pr	1	K	250	Sat	WT	124	19.0	None	None	None
44	University of Massachusetts	Amherst, Mass	Merrill Assoc	New	1958	Po	1	UI	250	450	WT	80	10.25	1.7	0.30	None
45	Federal Reserve Bank of Texas	Dallas, Texas	Zumwalt & Vinther	Ex	1960	Po, Sh	2	CE	235	Sat	WT	19	2.79	.....	.....	.....
46	University of New Mexico	Albuquerque, N M	A. D. Ford	Ex	1-60	Po, Pr, Sh	3	BW	235	500	WT	60	.....	None	None	None
47	Wichita Falls State Hospital	Wichita Falls, Tex	Zumwalt & Vinther	Ex	1959	Pr, Sh	2	EC	235	Sat	WT	27	3.1	None	None	None
48	Bronx State Hospital	Bronx, New York	Seelye, Stevenson, Value & Knecht	New	1960	Sh	4	IBW	232	400	WT[12]	50[9]	.....	.....	.....	.....
49	Rabun Mills	Rabun Gap, Ga	.....	Ex	.....	Pr	1	CE	225	Sat	WT	30	.....	.....	.....	.....
200 PSIG																
50	First District Association	Litchfield, Minn	.....	Ex	10-58	Po, Pr	3	JB	200	Sat	FT	25	.....	.....	.....	.....
51	Minnesota Cheese Producer's Assoc	Pine Island, Mich	.....	Ex	9-59	Pr	1	JB	200	Sat	FT	21	3.01	None	None	None
52	Oregon State College	Carvallis, Oregon	W. Bruce Morrison	Ex	12-59	Sh	1	UI	200	Sat	WT	50	5.12	None	None	None
53	Howard Smith Paper Mills Ltd	Cornwall, Ontario, Canada	Self	Ex	10-59	Pr	1	BW	200	Sat	WT	360	39.0	None	None	62
54	Southern Methodist Univ	Dallas, Texas	Pfeiffer, Dawson & Winston	Ex	.....	Pr, Sh	1	BW	200	Sat	WT	64	6.43	None	None	None

Bd - Balanced draft
BE - Bucket elevator
Be - Belt
BG - Gravity discharge bucket elevator
Bk - Bark
BL - Black Liquor
Bu - Bulldozer
C - Coal, Bituminous
CA - Carryall
Cds - Continuous discharge spreader

Cg - Chain grate
CS - Car shaker
DB - Dry bottom
Dgs - Dump grate stoker
Cyc - Cyclone
El - Electrostatic
Ex - Existing
Fl - Flight
FT - Fire tube
G - Gas

Lig - Lignite
Me - Mechanical
MF - Mass flow
Mr - Multiple retort
O - Oil
PC - Pulverized coal
Pd - Pressurized
Po - Power
Pr - Process
Rl - Rail

Re - Regenerative
Sat - Saturated
SC - Steam coil
Sr - Single retort
Sb - Self-unloading boat
Sh - Space heat
ST - Slag tap
Sw - Screw conveyor
Tg - Traveling grate
Th - Track hopper

Tr - Truck
Tu - Tubular
UF - Under feed
Ut - Unloading tower
Vs - Venturi scrubber
W - Water
WT - Water tube
Wd - Wood
AB - American Blower Div
AE - American Engineering Co

institutional power plants over 200 psi

Furnace volume 1000 cubic feet	Furnace heat release 1000 btu per cu ft per hr	Furnace type	Air heater type	Air heater manufacturer	Dust collector type	Dust collector manufacturer	NEW FIRING EQUIPMENT: Firing	Stoker type	Grate area, sq ft	Stoker mfr	Heating value 1000 Btu per lb	COAL HANDLING EQUIPMENT: Delivery method to plant site	Unloading equipment	Manufacturer	Stockpiling method	Stockpile to in-plant storage	Manufacturer	Covered storage facility	Manufacturer	In-plant handling equipment	Manufacturer	Weighing Equipment	Manufacturer	Project number
24.8	19.5	Bd	Re	APr	Me,El	RC	PC	None	.....	.....	13.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
24.6	18.9	DB	Re	APr	Me	AT	PC,O	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
.....	32.5	Bd	Tu,SC	BW,AB	Me	WP	BL	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3
27.4	27.6	Pd,ST	Re	APr	El	TC	PC,G[2]	None	.....	.....	.....	W,Rl	Ul,Th	Ex	Bu	Be	LB	Bunker	.....	Be	LB	Scale	SE	4
.....	66	Bd,ST	Re	.....	Me	.....	PC,O,G	.....	.....	.....	.....	Truck	.....	.....	.....	.....	.....	.....	.....	Be	.....	.....	.....	5
16.77	23.1	Bd,DB	Tu	RS	Me	PD	C,Bk	Tg,Cds	533	RS	12.2,4.45	Rail	Th	BLM	Bu	Be	BLM	Bunker	.....	Sw	BIM	Scale	BLM	6
30.80	.....	Bd	Tu	BW	Vs	BW	BL	None	.....	.....	6.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7
.....	.....	.....	.....	.....	.....	.....	PC	None	.....	.....	.....	Rl,Tr	CS,Th	.....	.....	Be	.....	Bunker	.....	Be	.....	.....	.....	8
13.78	.....	Bd,DB	Plate	APr	Me	WP	PC	None	.....	.....	.....	Rail	CS,Th	FE	Bu	Be,BE	FE	Bunker	FE	Be	FE	.....	.....	9
7.5	24.0	Bd	.....	.....	Me	AB	C	Cds	274	DSC	12.0	Rail	CS,Th	CoE	CA	BE	CoE	Bunker	.....	Be,BG	CoE	Scale	SE	10
10.58	.....	Pd	Re	APr	None	.....	O,G	None	.....	.....	1.073[11]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11
20.8	20	Bd	Tu	BW	None	.....	O, ...[3]	None	.....	.....	..... [4]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12
.....	.....	Bd	None	.....	Me	.....	Wd,Bk	Ul,Sr	.....	.....	.....	Be[5]	.....	.....	.....	Fl	LB	Bins	.....	Sw,Fl	LB	.....	.....	13
7.6	29.0	Bd	Tu	BW	Me	.....	Wood	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14
7.0	.....	Bd	Tu	RS	.....	.....	PC	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15
15.8	16.4	Bd,DB	Tu	CE	Me	PD	PC,G	None	.....	.....	11.25	Rail	.....	.....	.....	.....	.....	.....	.....	Be	LB	.....	.....	16
.....	.....	.....	.....	.....	.....	.....	Gas	None	.....	.....	1.05[11]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	17
.....	.....	Pd,ST	.....	.....	El	.....	O,BL	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18
2.1	31.5	Bd	None	.....	.....	.....	C	Cg	124	BW	.....	Truck	Th	.....	.....	.....	.....	Silo	.....	Be,Fl	WEB	Scale	FM	19
4.45	30	Bd	None	.....	Me	AB	C	Cds	215	DSC	12.24	Rail	Th,CS	NC	Bu	Be	JM	Bunker	.....	Be,BG	JM	Scale	RI	20
8.4	20.6	ST[7]	Re	APr	Me	PD	PC	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	21
9.7	21.3	Bd,DB	None	.....	Me	AB	C	Cds	375	DSC	13.8	Rail	Th	SA,GI	.....	Be,BE	SA,GI	Silo	.....	Fl	GI	Scale	SE,RI	22
5.7	20.0	Bd	None	.....	Me	PD	C	Og	195	RS	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	23
10.2	30	Pd	Re	APr	None	.....	Cyc,C	None	.....	.....	10.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	24
24.5	.....	Bd	SC	AB	El	RC	BL	None	.....	.....	6.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25
30.2	.....	Bd	SC	AB	El	RC	BL	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26
11	.....	Bd	Tu	BW	None	.....	.....[3]	None	.....	.....	..... [4]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	27
4.4	25.2	Bd	None	.....	Me	WP	C	Cds	203	RS	13.3	Rail	CS,Th	.....	.....	BE	WEB	Bunker	BT	Be,Fl,BG	WEB,SE	.....	.....	28
7.24	27.2	Bd	None	.....	Me	WP	C	Cds	290	DSC	12.3	Water	Ul	.....	Bridge	Be,BE	.....	Bunker	.....	Be	.....	Scale	RI	29
3.22	26.3	Bd	Re	APr	None	.....	Gas	.....	.....	.....	1.55[11]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30
1.91	.....	Bd	None	.....	None	.....	Gas	.....	.....	.....	1.11[11]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31
8.1	21.6	Bd	.....	.....	Me	FA	C	Cds	526	DSC	10.5	Rail	.....	.....	.....	.....	.....	.....	.....	Mf	SA	.....	.....	32
.....	.....	Bd	Tu	.....	Me	.....	Wd,BK	Dgs	.....	DSC	.....	Be[5]	.....	.....	.....	Fl	LB	Silo	MIH	Sw,Fl,BE	LB	.....	.....	33
.....	.....	Bd	Tu	.....	Me	.....	Wd,Bk	Dgs	.....	DSC	.....	Be[5]	.....	.....	.....	Fl	LB	Silo	MIH	Sw,Fl,Be	LB	.....	.....	34
.....	.....	Pd	Re	.....	None	.....	O,G	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	35
4.14	34.5	Pd	Re	APr	None	.....	Gas	None	.....	.....	1.025[11]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	36
2.28	.....	Bd	None	.....	None	.....	Gas	.....	.....	.....	1.38[11]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	37
1.83	29.2	Bd	Tu	JBW	Me	HCC	Ligg O	Cds	102	RS	6.7,18.5	Truck	Hopper	BB	.....	BE	BB	Silo	BB	.....	.....	.....	.....	38
1.33	47.4	Pd	None	.....	None	.....	O,G	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39
5.0	27.0	Bd	None	.....	Me	WP	Wd,Bk	Dgs	190	HCE	5.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40
0.89	.....	Pd	.....	.....	.....	.....	Oil	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	41
7.74	34.6	Pd	Re	APr	None	.....	Gas	.....	.....	.....	1.0[11]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	42
8.3	21.7	Bd	None	.....	Me	BU	Wd	.....[10]	256	RS	5.95	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	43
4.0	24.88	Bd	None	.....	None	.....	C	Ul,Mr	227	AE	13.5	Rl,Tr	PoC	SA	Bu	Be	SA	.....	.....	Be	.....	.....	.....	44
0.6	42.6	Bd	.....	.....	.....	.....	G,O	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	45
2.3	35	Bd	None	.....	None	.....	O,G	None	.....	.....	19,1.0[11]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	46
.....	.....	Bd	None	.....	None	.....	G,O	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	47
.....	.....	Bd	.....	.....	None	.....	Oil	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	48
.....	.....	Pd	None	.....	None	.....	Oil	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	49
.....	139	Pd	.....	.....	.....	.....	Oil	None	.....	.....	18.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50
.....	.....	Pd	None	.....	None	.....	Oil	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	51
.....	.....	Pd,DB	None	.....	None	.....	O,G	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	52
25	13	Bd	Tu	BW	Me	PRC	PC,O	None	.....	.....	.....	W,Tr,Rl	Sb,Th	JM	.....	BE	JM	Silo	TIW	Be	JM	.....	.....	53
1.86	46	Bd	None	.....	None	.....	Gas	None	.....	.....	1.0[11]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	54

APr - Air Preheater Corp
AT - The Aerotec Corp
BB - Beaumont Birch Co
BLM - B L Montague Co, Inc
BT - Buffalo Tank Corp
BU - Buell Engineering Co, Inc
BW - Babcock & Wilcox Co
CE - Combustion Engineering, Inc
CoE - Conveyor Engrg Co
DSC - Detroit Stoker Co
EC - Erie City Iron Works
El - Edge Moor Iron Works Div
FA - Fly Ash Arrestor Corp
FE - Fairfield Engineering Co
FM - Fairbanks, Morse & Co
GI - Gifford Wood Co
GS - Garrett & Shafey Engr Works
HCC - Hagan Chemicals & Control, Inc
HCE - Hoffman Combustion Engrg Co
IBW - International Boiler Works
JB - Johnston Bros Co
JM - Jeffrey Mfg Co
K - E Keeler Co
LB - Link Belt Co
MIH - Miller Hoffl Inc
NC - National Conveyors Co
PD - Prat-Daniel Corp
PRC - Precipitation Co
RC - Research-Cottrell, Inc
RI - Richardson Scale Co
RS - Riley Stoker Corp
SA - Stephans-Adamson Mfg Co
SE - Stock Equipment Co
TC - The Thermix Corp
TIW - Toronto Iron Works
UI - Union Iron Works
VO - Henry Vogt Machine Co
WEB - Webster Mfg Inc
WI - Wickes Boiler Co
WP - Western Precipitation Corp
1 - Revised data, previously listed 12-57
2 - Cyclone
3 - Blast furnace gas
4 - 85 Btu per cu ft
5 - Conveyor from mill
6 - Turbo furnace
7 - Not scheduled yet
8 - To be purchased
9 - Million Btu per hr
10 - Stationary water-cooled grate, pneumatic spreader
11 - 1000 Btu per cu ft
12 - High temperature hot water
13 - Boilers originally used elsewhere

Industrial power plants over 200 psi continued

Project number	F. D. FANS			I. D. FANS			AIR & GAS FLOW CONTROL		SOOT BLOWERS			Ash handling system	Manufacturer	FEED WATER PUMPS					WATER TREATMENT				
	No. and drive	Fan mfr	Drive mfr	No. and drive	Fan mfr	Drive mfr	Air flow	Gas flow	No. per boiler	Type	Manufacturer			No. per boiler	Pump mfr	Drive type	Drive mfr	Pump control	Use	Flow rate	Softening	Demineralizing	Manufacturer
2000 TO 601 PSIG																							
1	1-M	SW	WE	1-M	SW	WE	V	V	23	St	CV	Pn,Hyd	ASH	2	WO	T	WE	S,Reg	Bf	40	.....	Mu	PF
2	1-M	AB	GE	1-T	AB	TE	D	D	21	St	DP	Hyd	ASH	2	PP	T	GE	S	Bf	1200	Ca	Mu	PF
3	1-M	CF	WE	1-M	CF	WE	D	Hyd	8	St	DP	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	2-Du	AB	EL	None	.....	.....	Hyd	.....	21	St	DP	Hyd	HA	2	PP	M,T	WE,EL	.....	Bf	2000	HLZ	.....	AC
5	1-M	AB	.....	1-M	AB	.....	V	Hyd	.....	St	DP	Hyd	UC	.....	IR	M	.....	Reg	.....	.....	.....	.....	.....
6	1-M	AB	ME	1-T	AB	WE	V	S	2	St	DP	Pn	ASH	3	BJ	M,T	ME,WE	Reg	Bf	350	.....	Mu	COC
7	1	CF	.....	2	CF	.....	V	S	22	St	DP	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
8	1	.....	.....	.....	.....	.....	.....	.....	.....	St	DP	Pn	UC	2	IR	M	.....	.....	.....	.....	.....	.....	.....
9	1-T	CF	EL	1-T	CF	EL	S,V	S,D	16	St	DP	Pn	UC	2	DL	T	EL	.....	Bf,Ma	50	Ca,HLZ	.....	.....
10	1-Du	CF	EL	1-Du	CF	EL	V	D	8	.....	CV	Pn	UC	2	PP	Du	EL,TE	Reg	.....	.....	.....	Mu	PF
11	2-T	AB	.....	None	.....	.....	S,D	.....	8	St	DP	None	.....	1	IR	T	.....	S,Hyd	Bf	830	HLZ	.....	COC
12	1-T	.....	.....	1-T	.....	.....	.....	.....	16	St	.....	None	.....	Ex	.....	.....	.....	.....	Ex	.....	.....	.....	.....
13	2-M	LJW	.....	1-T	SW	WO	V	D	4	St	DP	Me	.....	2	.....	Du	.....	.....	.....	.....	.....	.....	.....
14	1-T	SW	TE	1-T	SW	TE	D	D	4	St	.....	Manual	.....	2	IR	T	EL	Reg	Bf	.....	Ca,HLZ	.....	.....
15	1-M	SW	.....	1-M	PD	.....	.....	.....	.....	.....	DP	Pn	.....	1	IR	M	.....	Reg	Bf	.....	HLZ	.....	COC
16	1-M	SW	EL	1-M	SW	EL	D	D	16	St	DP	Pn	UC	2	IR	Du	WE,EL	.....	.....	.....	.....	Mu	.....
600 TO 401 PSIG																							
17	.....	.....	.....	1-T	GF	WE	.....	S,D	None	.....	.....	.....	.....	4	BJ	T	WE	.....	.....	.....	.....	.....	.....
18	1-M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	M	.....	.....	Bf	.....	Z	.....	.....
19	1-M	SW	US	1-M	SW	US	V	D	.....	.....	.....	Pn	UC	2	IR	M,T	US,WE	S	.....	.....	.....	.....	.....
20	1-T	AB	.....	1-T	AB	.....	S,V	S,V	.....	.....	.....	Pn	UC	3[15]	PP	M,T	GE,EL	Reg	Bf	.....	HLZ	.....	.....
21	1-T	SW	EL	1-T	SW	EL	S,V	S,D	1	St	DP	Hyd	ASH	1	AC	T	EL	S	Bf	.....	Z	.....	.....
22	1-Du	AB	EL	1-T	AB	EL	S,D	S,D	8	Air,St	DP	Pn	UC	3	IR	M,T	WE,EL	Reg	Bf	.....	.....	.....	.....
23	1-T	.....	.....	1-T	.....	.....	S	.....	None	.....	.....	Hyd	.....	16	WO	Du	RE,TE	S	Bf	450	Ca,CLZ	.....	.....
24	1-T	SW	EL	None	.....	.....	V	.....	12	St	DP	Hyd,Me	ASH	3	IR	T	GE	Reg	Bf	.....	Z	.....	.....
25	1-M	AB	WE	1-M	AB	WE	V	S	24	St	DP	.....	.....	2	IR	M,T	WE,EL	Reg	.....	.....	.....	.....	.....
26	1-M	AB	.....	1-M	AB	.....	D	Hyd	28	St	DP	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
27	1-T	SW	EL	1-T	SW	EL	S,D	S,D	12	St	DP	None	.....	1	17	T	17	S	Bf	500	Ca,HLZ	.....	.....
28	1-M	SW	GE	1-M	SW	GE	V	S	8	St	DP	Pn	UC	3[14]	IR	1-M,2-T	GE,WO	S	Bf	.....	.....	.....	.....
29	1-M	AB	GE	1-T	AB	GE	V	S	12	St	DP	Pn	UC	1	IR	M	GE	Reg	.....	.....	.....	.....	.....
400 to 251 PSIG																							
30	1-M	SW	LA	1-M	SW	LA	D	D	None	.....	.....	None	.....	2	IR	T	EL	Reg	.....	.....	.....	.....	.....
31	.....	.....	.....	1-M	SW	LA	.....	D	None	.....	.....	None	.....	1	IR	M	GE	Reg	.....	.....	.....	.....	.....
32	1-Du	CF	TE[17]	1-Du	CF	TE[17]	V	D	1	St	DP	Pn	ASH	2	IR	M	.....	Reg	.....	.....	.....	.....	.....
33	1-Du	.....	.....	1-Du	.....	.....	D	D	4	St	DP	.....	.....	2	AC	M,T	.....	.....	Bf	500	Z	.....	AC
34	1-Du	.....	.....	1-Du	.....	.....	D	D	4	St	DP	.....	.....	2	AC	M,T	.....	.....	Bf	500	Z	.....	AC
35	1-Du	.....	.....	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
36	1-T	SW	WO	None	.....	.....	D	.....	.....	.....	.....	.....	.....	2	.....	T	.....	.....	.....	.....	.....	.....	.....
37	.....	.....	.....	1-M	SW	LA	D	None	.....	.....	.....	.....	.....	1	IR	M	GE	Reg	.....	.....	.....	.....	.....
38	1-M	ROB	.....	1-M	AB	.....	D	.....	2	Air	DP	Pn	BB	18	WS	.....	.....	.....	Bf	.....	CLZ	.....	.....
39	1-M	AB	LA	None	.....	.....	V	.....	2	St	DP	None	.....	1	WO	1-M,2-T	GE,EL	S,Reg	Bf	114	CLZ	Mu	ES
250 TO 201 PSIG																							
40	1-M	CF	.....	1-M	CF	EM	V	D	8	St	BR	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
41	1-M	GF	.....	None	.....	.....	.....	.....	1	St	DP	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
42	1-T	SW	EL	None	.....	.....	V	.....	1	St	DP	None	.....	.....	.....	M,T	.....	.....	.....	.....	HLZ	.....	.....
43	1-M	BF	AC	1-T	BF	CT	D	S	.....	.....	.....	Pn	.....	2	WPI	M,T	AC,CT	.....	Bf	154	CLZ	.....	PF
44	1-Du	FA	.....	1-Du	.....	.....	.....	.....	10	St	DP	Me	.....	3	WPI	T	CT	Hyd	Bf	.....	.....	.....	.....
45	1-M	.....	FM	None	.....	.....	V	.....	.....	.....	.....	.....	.....	1	WO	.....	.....	.....	Bf	.....	Z	.....	.....
46	1-M	CF	.....	1-M	CF	.....	V	D	None	.....	.....	None	.....	1	WO	20	WO	.....	.....	.....	Z	.....	.....
47	1-M	BF	.....	1-M	BF	.....	D	D	.....	.....	.....	.....	.....	1	AC	M	.....	.....	Bf	.....	Z	.....	.....
48	1-M	.....	.....	.....	.....	.....	V	.....	2	Air	DP	.....	.....	5	WS	M	.....	.....	.....	.....	Z	.....	.....
49	1-M	FM	.....	None	.....	.....	D	.....	1	St	DP	None	.....	1	AM	M	.....	Reg	Bf	.....	Z	.....	.....
200 PSIG																							
50	1-M	CF	.....	None	.....	.....	D	.....	.....	.....	.....	.....	.....	22	WO	M	.....	.....	Bf	.....	.....	.....	.....
51	1-M	.....	.....	None	.....	.....	.....	.....	None	.....	.....	None	.....	1	.....	T	.....	Reg	Bf	.....	Z	.....	.....
52	1-M	BF	.....	None	.....	.....	.....	.....	2	St	DP	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
53	2-M	ASP	TAE	1-M	ASP	TAE	V	V	8	St	DP	Pn	ASH	1	CIR	T	WO	S	Bf	500	.....	.....	PF
54	None	.....	.....	1-M	AB	.....	.....	D	None	.....	.....	None	.....	Ex	.....	2-M,1-T	GE,WO	S,Reg	Bf	.....	Z	.....	.....

A-e - Auto-extraction
Bf - Boiler feed
Ca - Coagulator
Cb - Control board
Con - Condensing
Cen - Centralized
CLZ - Cold lime zeolite
Ct - Cooling tower
D - Damper
Dec - Decentralized
Du - Dual drive
E - Electrical
Ex - Existing
H2 - Hydrogen
HLZ - Hot lime zeolite
Hyd - Hydraulic
J - Steam jet
M - Motor
Mu - Multibed
N-C - Non-condensing
Ma - Makeup
Me - Mechanical
Pn - Pneumatic
Reg - Regulator
S - Speed
Sp - Spray pond
St - Steam
Su - Surface
T - Turbine
V - Vane
Z - Zeolite
AB - American Blower Div
AC - Allis Chalmers Mfg Co
AM - American-Marsh Pumps, Inc
ASH - Allen-Sherman-Hoff Co
ASP - American Standard Products Co
BB - Beaumont Birch Co
BF - Buffalo Forge Co
BJ - Byron Jackson Pumps, Inc
BM - Bailey Meter Co
BR - A J Bayer Co
CF - Clarage Fan Co
CHW - C H Wheeler Mfg Co
CIR - Canadian Ingersoll Rand Co, Ltd
COC - Cochrane Co
CSE - Condenser Service & Engrg Co, Inc
CT - Carling Turbine Blower Co
CV - Copes-Vulcan Div, Blaw-Knox Co
DL - De Laval Steam Turbine Co
DP - Diamond Power Specialty Co

Compiled by:
J. W. Follansbee, Assistant Editor

Combustion control	Control manufacturer	TURBINES												CONDENSERS					Boiler controls	Total plant boiler capacity	Project number
		Number	Throttle press. psig	Throttle temp. F	Manufacturer	Capacity, kw	Type	RPM	Back pressure, psia	No. of bleed points	No. of auto-extraction points	Deaerating heater pressure, psig	Generator cooling	Type	Manufacturer	No. of water passes	Cooling water	Condensate air removal			
Pn,E	HCC	2	1800	1000	WE	53,000	Con,A-e	3600	0.75	.....	5	100	H_2	Su	WE	2	River	J	Con	750	1
Pn	RF	1	1450	880	WE	18,800	Con,A-e	3600	1.0	None	2	3	H_2	Su	FW	2	River	J	Dec	1200	2
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	599	3
Pn	BM	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Dec	500	4
E	RF	1	900	835	GE	10,000	N-C	3600	175	.....	.....	2	H_2	None	.....	.....	.....	.....	Con	600	5
Pn	BM	1	850	825	GE	22,059	Con,A-e	3600	1.0	.....	2	75	H_2	Su	CHW	2	.....[12]	J	Dec	481	6
Pn	BM	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	481	7
.....	.....	1	.....	.....	GE	5,000	Con,A-e	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8
Pn	RF	1	800	825	DL	.....	A-e	.....	1.0	1	1	8	Air	Su	EL	4	River	J	Dec	402	9
Pn	RF	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	355	10
Pn	BM	.....	.....	.....	.....	.....[13]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Cb	1770	11
Pn	.....	2	675	825	.....	.....	Con	.....	1	.....	.....	.....	None	Su	.....	2	Lake	.....	.....	1250	12
Pn	BM	1	225	600	WO	2,000	Con	3600	.....	1	.....	5	Air	Su	WO	2	Well	J	Con	95	13
Pn	BM	1	600	750	GE	7,500	Con,A-e	3600	1.0	1	1	5	Air	Su	IR	1	Sp	J	Dec	495	14
Pn	RF	1	400	600	GE	3,950	A-e	3600	40	1	.....	.....	Air	Su	WE	1	Well	.....	Con	230	15
Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Dec,Cb	1000	16
Pn	BM	3	600	600	WO	1,500	A-e	5500	65	1	1	.....	Air	.....	GB	8	Ocean	J	Con,Cb	360	17
Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Cb	.....	18
Pn	BM	1	600	750	WE	3,000	N-C	.....	115	.....	.....	3	Air	None	.....	.....	.....	.....	Dec	340	19
E	HC	1	600	725	GE	3,500	N-C	3600	175	.....	.....	15	Air	None	.....	.....	.....	.....	Dec	360	20
Pn	BM	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	21
Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Con	257	22
Pn	RF	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	180	23
Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	24
Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25
Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2370	26
.....[17]	.....	1	400	750	DL	12,000	Con	2550	1.25	None	None	5	.....	Su	CHW	2	River	J	Dec,Cb	365	27
Pn	HCC	3	400	600	.....	.....	N-C	.....	.....	.....	.....	5	Air	None	.....	.....	.....	.....	Dec	280	28
Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	300	29
Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	70	30
Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	180	31
Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Dec	365	32
Pn	BM	1	375	600	WO	4,000	Con,A-e	3600	125	None	1	5	Air	Su	WO	1	Well	J	Con	120	33
Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	34
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	35
Pn	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	550	36
Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	85	37
Pn	HCC	None	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	134[19]	38
Pn	BM	1	250	500	DL	1,000	N-C	6732	30	None	None	15	Air	None	.....	.....	.....	.....	Con,Cb	150	39
Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40
E	TR	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	41
Pn	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	42
E	HC	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	124	43
Pn	HCC	3	190	450	GE	1,500 500 300	N-C	3600	18	None	.....	15	Air	None	.....	.....	.....	.....	.....	180	44
Pn	RF	2	230	Sat	EL	.....	Con	.....	52	.....	.....	.....	.....	Su	.....	.....	Ct	J	Dec	38	45
Pn	BM	1	235	500	WE	450[21]	Con	.....	10	None	.....	2	None	Su	CSE	2	Well,Sp	J	.....	140	46
Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	65	47
E	HC	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Cb	200[19]	48
Pn	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	100	49
E	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	77.4	50
E	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	775	51
Pn	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	52
Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	820	53
Pn	RF	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	120	54

EL - Elliott Co
EM - Electric Machinery Mfg Co
ES - Elgin Softener Corp
FA - Fly Ash Arrestor Corp
FM - Fairbanks, Morse & Co
FW - Foster Wheeler Corp
GB - Goslin-Birmingham Mfg Co, Inc
GE - General Electric Co
GF - Green Fuel Economizer Co, Inc
HA - Hydro-Asn Corp
HC - The Hays Corp
HCC - Hagan Chemicals & Controls, Inc
IR - Ingersoll-Rand
LA - The Louis Allis Co
LJW - L J Wing Mfg Co
ME - Marathon Electric Mfg Corp
PD - Prat-Daniel Corp
PF - Pfaudler-Permutit Permutit Co, The, A Div of Pfaudler Permutit, Inc
PP - Pacific Pumps, Inc
RE - Reliance Electric & Engr Co
RF - Republic Flow Meters Co
ROB - Robinson Ventilating Co
SW - Sturtevant Div, Westinghouse Electric Corp
TAE - Tamper Electric Ltd
TE - Terry Steam Turbine Co
TR - Todd-Rimcor
UC - United Conveyor Corp
US - U S Electrical Motors, Inc
WE - Westinghouse Electric Corp
WO - Worthington Corp
WPI - Warren Pumps, Inc
WS - Wilson-Snyder Works, U S Steel Corp
12 - Treated mill water
13 - Turbines drive blast furnace blowers
14 - 3 pumps for 4 boilers
15 - Serve entire plant
16 - 1 pump for 2 boilers
17 - Not yet purchased
18 - 3 for 2 boilers
19 - Million Btu per hr
20 - Reciprocating steam engine
21 - Turbines drive air conditioning compressors
22 - 4 pumps for 3 boilers

1959 design survey: typical industrial,

Compiled by:
J. W. Follansbee, Assistant Editor

Project number	Company & location	Consulting engineers	New or existing plant	Date of initial operation	Principal steam use	NEW BOILERS: Number new boilers	Manufacturer	Oper press, psig	Oper temp, F	Boiler type	Capacity each, 1000 lb per hr	Boiler and waterwall Surface, 1000 sq ft	Furnace volume 1000 cubic feet	Furnace heat release, 1000 Btu per cu ft per hr	Furnace type	NEW FIRING EQUIPMENT: Firing	Stoker type	Stoker mfr	Heating value 1000 Btu per lb
199 to 160 PSIG																			
1	University of Washington, Seattle, Wash.	Bouillon, Griffith & Christofferson	Ex	8-59	Sh	1	RS	185	Sat	WT	100	.....	.....	.....	Bd	PC,G	.....	.....	.....
2	El Paso Natural Gas Co., Kermit, Texas	.....	Ex	3-59	Pr	1	VO	175	Sat	WT	45	5.77	1.84	.....	Bd	Gas	.....	.....	1.1
3	Oregon State Correctional Inst., Salem, Oreg.	W. Bruce Morrison	New	7-59	Pr,Sh	3	MEA	175	Sat	WT	20	2.4	.....	.....	Pd	O,G	.....	.....	.....
4	Pigeon Falls Coop., Pigeon Falls, Wis.	Coal Burning Equipment Co.	Ex	.....	Pr	1	K	175	Sat	WT	20	.....	.....	.....	Bd	C	Dgs	BAE	12.5
5	Sears, Roebuck & Co., Philadelphia, Pa.	H. M. Wilson Co.	Ex	10-59	Sh	4	K	175	430	WT	40	6.0	2.0	250	Bd	O,G	.....	.....	18,1.04
6	Colgate Palmolive Ltd., Toronto, Canada	.....	Ex	5-59	Pr	1	BWG	170	375	WT	35	5.0	1.0	.....	Bd	Oil	.....	.....	18.0
7	R. J. Reynolds Co., Stokes County, N. C.	Stone & Webster Engr Corp	New	.....	Pr	3	BW	170	375	BT	70	7.73	2.68	31.2	Bd	C	Cds	.....	.....
8	R. J. Reynolds Co., Winston-Salem, N. C.	Stone & Webster Engr Corp	New	.....	Pr	3	UI	170	375	WT	100	8.27	4.1	28.4	Bd	C	Cds	DSC	12.4
9	Revere Sugar Refinery, Charlestown, Mass.	.....	Ex	.....	Pr	1	CE	165	Sat	WT	90	.....	.....	.....	Bd	Oil	.....	.....	.....
10	Griffiss Air Force Base, Rome, N.Y.	.....	New	1959	Sh	3	K	160	Sat	WT	46	7.03	.....	.....	Bd	C	Tg,Cds	AE	13.0
159 to 150 PSIG																			
11	Bethlehem Steel Co., Sparrows Point, Md.	United Engrs. & Constr. Inc.	Ex	8-59	Pr	3	EC	150	500	WT	60	.....	.....	.....	Pd	Oil	.....	.....	.....
12	El Paso Natural Gas Co., Opal, Wyoming	.....	New	2-59	Pr	1	VO	150	Sat	WT	40	4.98	1.6	.....	Bd	Gas	.....	.....	1.1
13	Golden Bear Oil Co., Oildale, Cal.	D. G. Reynolds Co.	New	.....	Po,Pr	1	UI	150	Sat	WT	35	3.6	0.96	.....	Pd	O,G	.....	.....	.....
14	Md-Va Milk Products, Laurel, Md.	Power & Combustion, Inc.	Ex	6-59	Pr	1	K	150	Sat	WT	33	.....	.....	.....	Pd	Oil	.....	.....	.....
15	Medical Center Steam Co., Chicago, Ill.	Stone & Webster Engr Corp	Ex	10-59	Sh	2	BW	150	400	WT	90	10.23	3.8	27.8	Bd,DB	C,O,G	Tg	BW	.....
16	Penn Dairies,	John K. Cushman	Ex	.....	Pr	1	K	150	Sat	WT	20	.....	.....	.....	Pd,DB	Oil	.....	.....	.....
17	Polk State Hospital, Polk, Pa.	Swindell-Dresler Corp.	Ex	6-59	Po,Sh	4	UI	150	Sat	WT	35	.....	.....	.....	Bd	C	Uf,Mr	AE	13.0
18	Ranchers Cotton Oil, Fresno, California	.....	Ex	10-58	Pr	1	UI	150	Sat	WT	30	3.60	0.88	.....	Pd	Gas	.....	.....	.....
19	State Hospital, Goldsboro, N. C.	Wiley & Wilson	Ex	8-59	Pr,Sh	1 1	EC UI	150	360	WT[4]	40[5]	10.53	.....	736[6]	Bd	C	Cds,Tg	EC	34
20	Tri Valley Packing Assoc., Stockton, Cal.	.....	Ex	8-59	Pr	1	UI	150	Sat	WT	30	3.56	.....	.....	Pd	O,G	.....	.....	.....
21	Turtle Lake Creamery, Turtle Creek, Wis.	Klinger & Assoc.	....	.....	Pr	2	B	150	Sat	WT	25	.....	.....	.....	Pd	O,G	.....	.....	.....
22	University of Nebraska, Omaha, Nebraska	Henningson, Durham & Richardson	Ex	11-58	Pr,Sh	1	B	150	367	WT	35	4.2	0.946	25.0	Bd	O,G	.....	.....	18.5,1.0
23	Western Wool Processors, Rockyford, Col.	.....	New	6-59	Pr	1	CB	150	Sat	FT	10.3	.....	.....	.....	Pd	Gas	.....	.....	.....
149 to 120 PSIG																			
24	University of Alabama, University, Alabama	Self	Ex	1959	.....	1	VO	140	Sat	WT	60	9.50	2.95	.....	Bd	C	Uf,Mr	AE	13.2
25	Libby McNeil & Libby, Chicago, Ill.	A. Epstein & Sons	New	11-59	Pr,Sh	2	UI	135	358	WT	80	6.3	1.19	70	Pd	O,G	.....	.....	18.0,1.0
26	State Sanitorium, Oakdale, Iowa	Stanley Engineering Co.	Ex	10-60	Sh	3	BC	130	355	WT	15 25	2.6 3.94	0.670	29.5	Bd	C,G	Dgs	RS	.....
27	Ann Arbor Public Schools, Ann Arbor, Mich.	Wayne Bird	New	9-60	Sh	2	JB	125	Sat	FT	10	15.0	.....	116	Pd	G,O	.....	.....	.....
28	Arkansas Baptist Hospital, Little Rock, Ark.	Erhart, Eisenbaum & Rauch	New	10-59	Pr,Sh	2	CB	125	Sat	FT	8.6	1.25	.....	.....	Pd	Gas	.....	.....	1.0
29	Bluemont Knitting Mills, Galax, Va.	.....	....	7-59	Pr	1	K	125	Sat	WT	25	.....	.....	.....	.....	C	Uf,Sr	DSC	.....
30	The Carling Breweries Ltd, Montreal, Quebec	Same	Ex	5-58	Pr	1	BW	125	Sat	WT	33	4.37	1.06	27.7	Pd	Oil	.....	.....	.....
31	Ciba Pharmaceutical Prod., Inc., Summit, N.J.	.....	Ex	1-59	Pr,Sh	1	BW	125	Sat	WT	30	3.31	.....	.....	Pd	Oil	.....	.....	.....
32	Collins & Aikman Corp, Cavel, N. C.	The McPherson Co.	....	5-59	Pr	1	UI	125	Sat	WT	60	8.06	2.5	29.9	Bd	C	Vg	AE	13.5
33	The Globe Wernicke Co., Norwood, Ohio	.....	Ex	7-59	Po,Pr	1	BW	125	Sat	WT	20	2.2	.....	.....	Bd,DB	Gas	.....	.....	.....
34	Harvard University, Cambridge, Mass.	Chas. T. Main, Inc.	Ex	11-58	Sh	2	RS	125	Sat	WT	80	8.2	.....	25.3	Bd	Oil	.....	.....	.....
35	Haskell Institute, Lawrence, Kansas	Wilson & Co.	Ex	9-58	Sh	3	K	125	Sat	WT	20	.....	.....	50	Pd	O,G	.....	.....	.....
36	Haskell Institute, Lawrence, Kansas	Wilson & Co.	Ex	9-58	Sh	1	K	125	Sat	WT	15	.....	.....	50	Pd	Gas	.....	.....	.....
37	Michigan Fruit Canners Inc., So. Haven, Mich.	Johnston Bros, Inc.	New	6-59	Pr,Sh	1	JB	125	Sat	FT	26	.....	.....	.....	Pd	Oil	.....	.....	.....
38	New Idea Div., Avco Corp, Coldwater, Ohio	Fosdick & Hilmer	Ex	11-59	Sh	1	CE	125	Sat	WT	37	3.38	.....	.....	Pd	Oil	.....	.....	.....
39	J. Schlitz Brewing Co., Tampa, Florida	Stone & Webster Engrg. Corp.	New	1-59	Pr	2	CE	125	Sat	WT	36	.....	.....	.....	Pd	Oil	.....	.....	18.5
40	Scottdale Mills, Scottdale, Ga.	Keck Engr. Assoc.	New	5-58	Pr	1	BW	125	Sat	WT	16	17	0.41	50	Pd	O,G	.....	.....	.....
41	Smith Corona Marchant Inc., S. Cortland, N.Y.	Robson & Woes	New	8-59	Pr,Sh	2	K	125	353	WT	25	.....	.....	.....	Bd	O,G	.....	.....	.....
42	Charles G. Summers Jr, Inc, New Freedom, Pa	.....	Ex	.....	Pr	1	K	125	Sat	WT	10	.....	.....	.....	Pd	C	Uf,Sr	DSC	.....
43	Western State College, Gunnison, Col.	Stone & Birkle	Ex	12-59	Sh	1	....[2]	125	325	WT	55	7.5	2.1	35	Bd	C	CG	.....	.....
44	Burns & Co., Ltd., Winnipeg, Manitoba, Can.	Angus Butler & Assoc	New	8-59	Pr,Sh	2	BWG	120	Sat	WT	20	.....	2.53	50.6	Pd	Oil[8]	.....	.....	.....
100 PSIG																			
45	Baltimore City Jail, Baltimore, Md.	Whitman, Requardt & Assoc.	New	6-60	Sh	2	....	100	Sat	WT	30	4.3	1.0	30	Bd	Oil	.....	.....	18
46	Bissell Carpet Sweeper Co., Grand Rapids, Mich.	J. & G. Daverman Co.	New	6-59	Pr,Sh	2	CB	100	Sat	FT	17.3	.....	.....	.....	Pd	O,G	.....	.....	.....
47	Endura Corporation, Quakertown, Pa.	.....	Ex	6-59	Pr,Sh	2	AI	100	338	FT	10	1.27	.....	.....	Pd	Oil	.....	.....	.....
48	Boeing Airplane Co., Renton, Washington	Austin Associates	New	6-59	Pr,Sh	3	CB	100	310	FT[4]	21[5]	.....	.....	.....	Pd	O,G	.....	.....	18
49	Old Age & Survivors Ins. Bldg., Baltimore, Md.	Whitman Requardt & Assoc.	New	6-60	Sh	3	EC	100	Sat	WT	25	3.27	1.37	17.4	Pd	Oil	.....	.....	.....
50	Radford College, Radford, Virginia	.....	Ex	1958	Pr,Sh	1	UI	100	Sat	WT	35	5.50	1.40	32.9	Bd	C	Vg	AE	13.5
51	Sunshine Hospital, Grand Rapids, Michigan	Stuart Long Co.	Ex	1-59	Pr,Sh	1	JB	100	338	FT	12	.....	.....	11	Pd	Gas	.....	.....	1.0
52	Supreme BF Co., Lubbock, Texas	Wyatt Hedrick	New	5-59	Pr	1	CB	100	340	FT	12	.....	.....	.....	Pd	Gas	.....	.....	1.0
53	The Torrington Co., Torrington, Conn.	Perfection Grate & Stoker Co.	Ex	7-59	Pr,Sh	1	UI	100	338	WT	20	2.41	0.59	.....	Pd	Oil	.....	.....	18.5
54	Western Electric Co., Inc., Grandview, Mo.	United Engrs. & Constr., Inc.	New	1959	Pr	1	EC	100	Sat	WT	15	2.5	.....	.....	Pd	Gas	.....	.....	1.0
55	Western State Hospital, Staunton, Va.	.....	Ex	1958	.....	1	EC	100	Sat	WT	35	5.52	1.45	30.3	Bd	C	Vg	AE	13.5

Bd - Balanced draft
Be - Belt
BE - Bucket elevator
BG - Gravity discharge bucket elevator
C - Coal, bituminous
Cds - Continuous discharge stoker
CG - Chain grate stoker
DB - Dry bottom
Dgs - Dump grate stoker
Du - Dual
E - Electrical
Ex - Existing plant or equipment
Fl - Flight
FT - Fire tube

G - Gas
Hyd - Hydraulic
M - Motor
Me - Mechanical
Mr - Multiple retort
O - Oil
PC - Pulverized coal
Pd - Pressurized
Pn - Pneumatic
Po - Power
Pr - Process
Rl - Rail
Sat - Saturated
Sh - Space heat

Sr - Single retort
Sw - Screw conveyor
T - Turbine
Tg - Traveling grate
Tr - Truck
Uf - Under feed
Var - Various
Vg - Vibrating grate
WT - Water tube
AB - American Blower Div
AC - Allis-Chalmers Mfg Co
AE - American Engineering Co
AI - Ames Iron Works, Inc
AM - American Marsh Pumps, Inc

AU - Aurora Pump Div
AWS - American Water Softener Co
B - Bros, Inc
BAE - Baker Engrg Co
BB - Beaumont Birch Co
BBC - Bailey Blower Co
BC - The Bigelow Co
BF - Buffalo Forge Co
BK - Brooks Motors
BM - Bailey Meter Co
BR - A J Bayer Co
BS - Buffalo Scales
BU - Buell Engineering Co, Inc
BW - Babcock & Wilcox Co

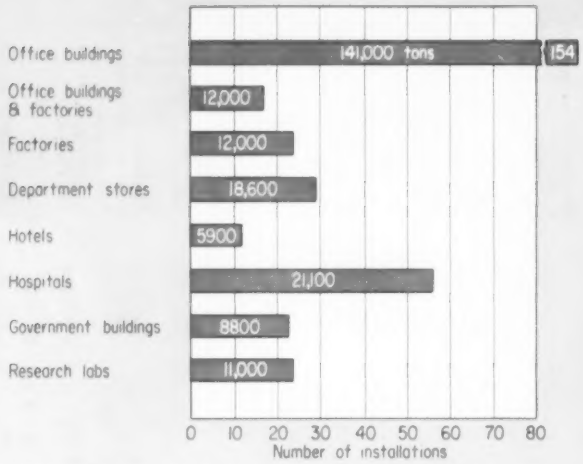
BWG - Babcock Wilcox & Goldie-McCullough Ltd
CB - Cleaver Brooks Co
CBC - Chicago Blower Corp
CBF - Canadian Blower & Forge Co Ltd
CC - Coen Co
CE - Combustion Engineering Co
CEC - Continental Electric Co
CF - Clarage Fan Co
CGC - Continental Gin Co
CGE - Canadian General Electric Co, Ltd
COM - Combustion Control Div, Electronics Corp of America
COP - Coppus Engineering Corp

institutional power plants under 200 psi

COAL HANDLING EQUIPMENT							F.D. FANS			I.D. FANS			SOOT BLOWERS			FEED WATER PUMPS					WATER TREATMENT						
Delivery method to plant site	Stockpile to in-plant storage	Covered storage facility	In-plant handling equipment	Manufacturer	Weighing equipment	Manufacturer	No. and drive	Fan mfr	Drive mfr	No. and drive	Fan mfr	Drive mfr	No. per boiler	Manufacturer	Ash handling system	Number per boiler	Pump manufacturer	Drive type	Drive mfr	Low water cutoff and control mfr	Type	Manufacturer	Combustion control	Control manufacturer	Total plant boiler capacity 1000 lbs per hr	Project number
199 to 165 PSIG																										
Rail	.....	Bins	Sw,BG	LB	Scale	SE	1-T	.....	EL	1-T	.....	EL	.....	DP	Pn	Ex	.....	.....	.....	.....	.....	.....	Pn	BM	.....	1
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1-M	FA	LA	.....	.....	.....	1	IR	M	GE	.....	So	.....	Pn	BM	65	2
.....	.....	.....	.....	.....	.....	.....	1-M	.....	.....	None	.....	.....	1	DP	None	.....	CC	...	.....	.....	.....	.....	E	CC	.....	3
Truck	Fl,BE	Bins	Fl	BAE	.....	.....	1-M	BBC	GE	None	.....	.....	1	.....	.....	2	WO,FM	M	WE,LA	MH	.....	.....	E	MH	35	4
.....	.....	.....	.....	.....	.....	.....	1-M	LJW	.....	.....	.....	.....	3	DP	None	.....	.....	...	.....	.....	.....	.....	E	HC	210	5
.....	.....	.....	.....	.....	.....	.....	1-Du	CSL	CGE	1-M	CSL	CGE	2	CV	.....	Ex	.....	...	.....	.....	.....	.....	Pn	BM	105	6
Rail	Be	Silo	Sw,BG	CGC	Scale	SE	1-Du	GF	GE,TE	1-Du	GF	GE,TE	2	DP	Pn	.....	IR	M,T	GE,TE	.....	So	.....	Pn	BM	210	7
Rail	Be	Silo	Sw,BG	.....[2]	Scale	.....[2]	1-Du	.....[2]	.....[2]	1-Du	.....[2]	.....[2]	4	.....[2]	Pn	2	.....[2]	Du	.....[2]	.....	So	.....[2]	Pn	.....[2]	300	8
.....	.....	.....	.....	.....	.....	.....	1-M	FA	.....	1-M	FA	.....	.....	.....	.....	.....	.....	...	.....	.....	.....	.....	Pn	HCC	.....	9
Rail	Fl,Sw	Silo	BG	BB	Scale	BS	1-Du	AB	CEC,CT	1-Du	PD	CEC,CT	4	CV	Pn	1	KP	Du	EM,CT	CV	So	.....	E	HC	138	10
159 to 150 PSIG																										
.....	.....	.....	.....	.....	.....	.....	1-M	BF	.....	None	.....	.....	4	CV	.....	1	WO	M	.....	RF	So	....	Pn	Var	180	11
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1-M	BF	LA	.....	.....	.....	2	IR	M	GE	.....	.....	....	Pn	BM	40	12
.....	.....	.....	.....	.....	.....	.....	1-M	CC	GE	None	.....	.....	2	DP	.....	1	WO	M	GE	BM	So	....	Pn	.....	.....	13
.....	.....	.....	.....	.....	.....	.....	1-M	CF	.....	None	.....	.....	1	CV	.....	1	.....	M	.....	MA	.....	....	E	TR	.....	14
.....	.....	Bunker	Be	.....	Scale	RI	1-M	BF	GE	1-M	GF	GE	13	DP	Pn	1	IR	M	GE	.....	So	....	Pn	RF	405	15
.....	.....	.....	.....	.....	.....	.....	1-M	LJW	.....	None	.....	.....	2	.....	None	1	WO	M	.....	MA	De	AC	E	.....	.....	16
Rail	.....	.....	BE	WEB	Scale	RI	1-M	CBC	GE	1-M	CBC	GE	5	BR	Me	.....[3]	DHP,GP	M	WE	.....	.....	....	E	HC	140	17
.....	.....	.....	.....	.....	.....	.....	1-M	CC	FM	None	.....	.....	.....	.....	None	2	IR,FM	M	.....	.....	So	....	E	CC	.....	18
Rail	BE	.....	Fl,BG	FE	Scale	BB	1-Du	BF	GE,TE	1-Du	BF	GE,TE	5	CV	Pn	1	IR	M	WE	.....	None	....	E	HC	181	19
.....	.....	.....	.....	.....	.....	.....	1-M	.....	.....	None	.....	.....	None	.....	None	1	FM	M	FM	MH	.....	...	E	MH	90	20
.....	.....	.....	.....	.....	.....	.....	1-M	LJW	.....	None	.....	.....	1	CV	None	1	WO	M	LA	SWC,RIM	De	PF	E	HC	.....	21
.....	.....	.....	.....	.....	.....	.....	1-M	.....	.....	.....	.....	.....	None	.....	None	.....	.....	...	.....	.....	.....	....	E	HC	AB	22
.....	.....	.....	.....	.....	.....	.....	1-M	CB	.....	None	.....	.....	None	.....	None	1	DC	M	.....	.....	.....	....	.....	.....	.....	23
149 to 120 PSIG																										
RI,Tr	Sw,BE	Silo	Sw,BE	CGC	None	.....	1-M	FA	GE	None	.....	.....	5	DP	Hyd	1[7]	.....	M,T	.....	.....	.....	....	Pn	HCC	160	24
.....	.....	.....	.....	.....	.....	.....	1-M	SW	WE	None	.....	.....	2	DP	.....	1	.....[2]	M	.....[2]	.....	So	AWS	E	HC	160	25
.....	.....	.....	.....	.....	.....	.....	1-M	AB	EL	1-M	AB	EL	3	BR	Pn	.....[2]	.....	...	.....	.....	So	....	.....	.....	80	26
.....	.....	.....	.....	.....	.....	.....	1-M	CF	LA	.....	.....	.....	.....	.....	.....	1	FM	M	HEM	MM	.....	....	E	MH,COM	.....	27
.....	.....	.....	.....	.....	.....	.....	1-M	CB	US	None	.....	.....	.....	.....	.....	1	AU	M	BK	.....	.....	....	COM,MH	.....	17.3	28
Truck	.....	.....	Sw	HB	.....	.....	1-M	CF	.....	1-M	CF	.....	1	CV	.....	1	PPD	M	.....	MA	.....	....	Hyd	.....	40	29
.....	.....	.....	.....	.....	.....	.....	1-M	CSL	.....	None	.....	.....	2	DP	.....	1	.....	M	.....	RF	.....	....	Pn	RF	65	30
.....	.....	.....	.....	.....	.....	.....	1-M	GF	FM	None	.....	.....	1	DP	.....	2	WO	M	.....	RIM,MA	So	....	Pn	BM	78	31
RI,Tr	Be,BE	Bunker	.....	.....	Scale	BB	1-Du	GF	FM,COP	1-T	GF	COP	3	DP	Pn	1	IR	T	TE	.....	.....	....	E	HC	140	32
.....	.....	.....	.....	.....	.....	.....	1-M	CF	.....	None	.....	.....	.....	.....	.....	2	AM	M,T	.....	RG	So	....	E	RIM	100	33
.....	.....	.....	.....	.....	.....	.....	1-T	BF	CT	1-T	AB	CT	5	DP	Pn	1	WPI	T	CT	.....	So	....	Pn	HCC	.....	34
.....	.....	.....	.....	.....	.....	.....	1-M	CC	.....	None	.....	.....	.....	.....	.....	1	GP	M	.....	RIM	.....	....	Pn	BM	.....	35
.....	.....	.....	.....	.....	.....	.....	1-M	CC	.....	None	.....	.....	.....	.....	.....	1	GP	M	.....	RIM	.....	....	Pn	BM	.....	36
.....	.....	.....	.....	.....	.....	.....	1-M	.....	.....	None	.....	.....	.....	.....	.....	1	AM	...	.....	.....	.....	....	.....	.....	.....	37
.....	.....	.....	.....	.....	.....	.....	1-M	P	.....	.....	.....	.....	1	DP	.....	.....	.....	...	.....	.....	.....	....	Pn	HCC	63	38
.....	.....	.....	.....	.....	.....	.....	1-M	.....	.....	None	.....	.....	.....	.....	.....	2	AU	M	.....	RIM	So	ES	.....	.....	.....	39
.....	.....	.....	.....	.....	.....	.....	1-M	GF	.....	None	.....	.....	None	.....	None	2	AM	M	.....	.....	Ca	....	E	HC	16	40
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	CV	None	2	.....	M,T	.....	MM	.....	....	Pn	.....	.....	41
Rail	.....	.....	.....	.....	.....	.....	1-M	.....	.....	None	.....	.....	1	.....	.....	1	WO	...	.....	.....	.....	....	Hyd	.....	.....	42
Truck	BE	Silo	BG	.....	.....	.....	1-M	.....	.....	1-T	.....	.....	6	.....	Pn	2	.....	Du	.....	.....	So	....	E	.....	90	43
.....	.....	.....	.....	.....	.....	.....	1-T	CBF	.....	None	.....	.....	1	DS	None	1[9]	.....	T	.....	RIM	So	....	Pn	BM	.....	44
100 PSIG																										
.....	.....	.....	.....	.....	.....	.....	1-M	.....	.....	.....	.....	.....	None	.....	None	1	.....	...	.....	.....	So	....	Pn	.....	75	45
.....	.....	.....	.....	.....	.....	.....	1-M	CB	.....	.....	.....	.....	.....	.....	.....	1	FS	M	.....	MA	.....	...	.....	.....	.....	46
.....	.....	.....	.....	.....	.....	.....	1-M	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	...	.....	.....	So	....	E	COM	.....	47
.....	.....	.....	.....	.....	.....	.....	1-M	CB	ME	None	.....	.....	None	.....	.....	1	VP	M	GE	.....	So	....	E	CB	63[5]	48
.....	.....	...	.....	.....	.....	.....	1-M	LJW	.....	None	.....	.....	3	CV	None	1	GP	2-M,1-T	GE,COP	.....	So	ES	E	RIM	75	49
Truck	BE	Bunker	Fl,BE	Self	Scale	BM	1-M	.....	GE	1-Du	.....	WE	2	DP	Me	2	.....	M,T	GE	.....	.....	....	E	HC	63	50
.....	.....	.....	.....	.....	.....	.....	1-M	.....	.....	None	.....	.....	.....	.....	.....	1	KM	M	WE	MM	.....	....	.....	.....	.....	51
.....	.....	.....	.....	.....	.....	.....	1-M	CB	.....	None	.....	.....	.....	.....	None	2	FS	M	.....	MA	So	....	.....	.....	.....	52
.....	.....	.....	.....	.....	.....	.....	1-M	SW	WE	None	.....	.....	2	CV	None	.....	.....	...	.....	MA	So	....	E	TS	60	53
.....	.....	.....	.....	.....	.....	.....	1-M	.....	.....	None	.....	.....	None	.....	.....	2	.....	M	.....	EC	.....	....	E	EC	.....	54
Rail	Chain	None	Sw	LB	.....	.....	1-M	CB	DM	1-M	FA	US	3	CV	Pn	1	AM	...	.....	CC	.....	....	E	HC	.....	55

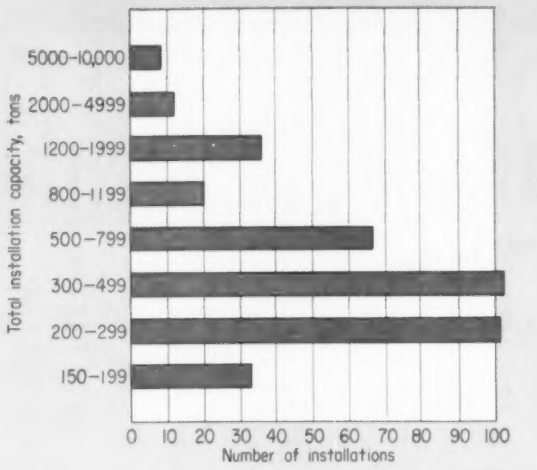
CSL - Canadian Sirrocco Co, Ltd
CT - Carline Turbine Blower Co
CV - Copes-Vulcan Div, Blaw-Knox Co
DC - Deming Co
DHP - Dean Hill Pump Co
DM - Diehl Mfg Co
DP - Diamond Power Specialty Co
DS - Diamond Specialty Ltd
DSC - Detroit Stoker Co
EC - Erie City Iron Works
EL - Elliott Co
EM - Electric Machinery Mfg Co
ES - Elgin Softener Corp
FE - Fairfield Engineering Co
FM - Fairbanks, Morse & Co
FS - Fred S Schaub Engrg Co
GE - General Electric Co
GF - Green Fuel Economizer Co, Inc
GP - Goulds Pumps Inc
HB - Hager Bros
HC - The Hays Corp
HCC - Hagan Chemicals & Controls
HEM - Howell Electric Motors Co
IR - Ingersoll-Rand Co
JB - Johnston Bros Co
K - E Keeler Co
KM - Kerr Machinery Co
KP - Ketchum Pump Co
LA - The Louis Allis Co
LB - Link Belt Co
LJW - L J Wing Mfg Co
MA - Magnetrol Inc
ME - Master Electric Div
MEA - Meco-Ames
MH - Minneapolis-Honeywell Regulator Co
MM - McDonnell & Miller, Inc
MR - Milton Roy
PD - Prat-Daniel Corp
PE - Peabody Engineering Corp
PF - The Permutit Co, A Div of Pfaudler Permutit, Inc
PPD - Peerless Pump Div, Food Machinery & Chemical Corp
RF - Republic Flow Meters Co
RG - Reliance Gage Column Co
RI - Richardson Scale Co
RIM - Reliance Instrument Co
RS - Riley Stoker Corp
SE - Stock Equipment Co
SW - Sturtevant Div, Westinghouse Elec Co
SWC - Swartwout Co
TE - Terry Steam Turbine Co
TR - Todd-Rimcor
TS - Todd Shipyards Corp, Products Div
UI - Union Iron Works
US - U S Electrical Motors, Inc
VO - Henry Vogt Machine Co
VP - Viking Pump Co
WE - Westinghouse Electric Co
WEB - The Webster Engrg Co
WO - Worthington Corp
WPI - Warren Pumps, Inc
1 - One pump for 3 boilers, one spare
2 - Equipment not yet purchased
3 - 3 pumps for 4 boilers
4 - High temperature hot water
5 - Million Btu per hr
6 - Btu per sq ft of grate area
7 - One pump serves all boilers
8 - Future gas
9 - One pump for two boilers

WHERE UNITS ARE INSTALLED



REPORTED SALES of industrial air-conditioning installations show office buildings taking 60%, industrials 5% of total tonnage

TONNAGE RANGE

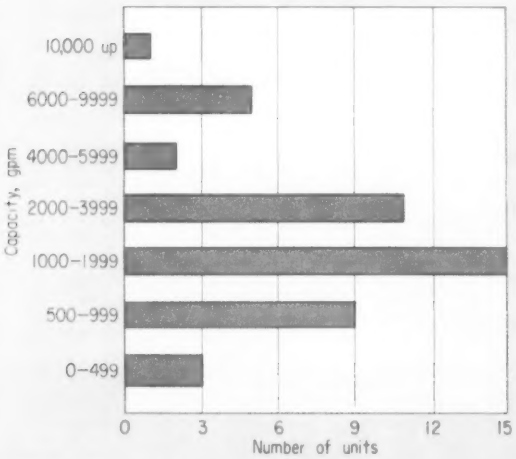


TOTAL CAPACITY covers wide tonnage range. Jobs of 800 tons up account for only 20% of installations, but half the tonnage

AIR CONDITIONING: industrials on upswing

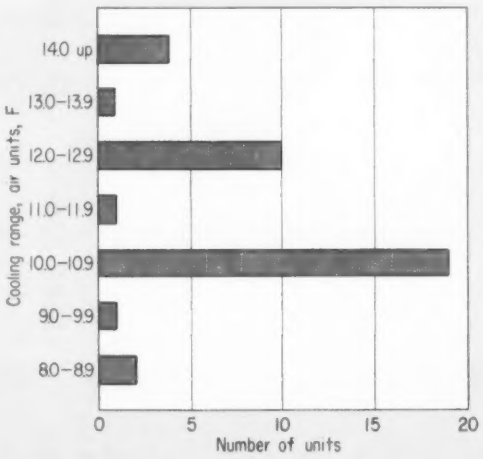
This air-conditioning survey, POWER's first, shows office buildings taking biggest chunk of cooling. Industrial-plant conditioning, though small percentage-wise, gives signs of growth. Here the potential is greatest. Future surveys will keep close tabs on direction engineering practice takes as more and more plants accept complete conditioning systems, whether for process or comfort

COOLING-TOWER SIZES



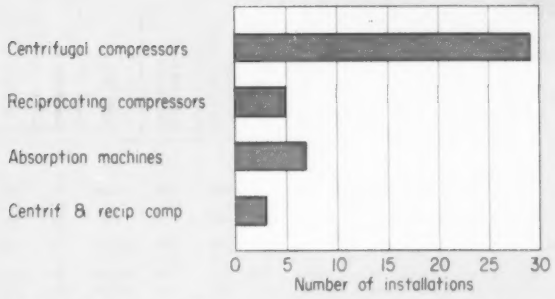
TOWER CAPACITIES go up to 11,300 gpm per tower, yet 95% of tower systems handle 2.8-3.8 gallons of water per ton of cooling

HEAT-TRANSFER RANGE



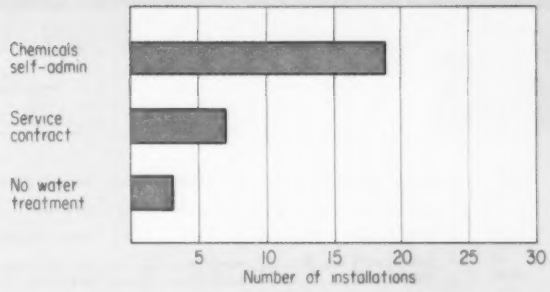
TEN-DEGREE temperature rise of water through cooling coils finds greatest favor as design factor. Low, high ranges are few

REFRIGERANT-MACHINE TYPES



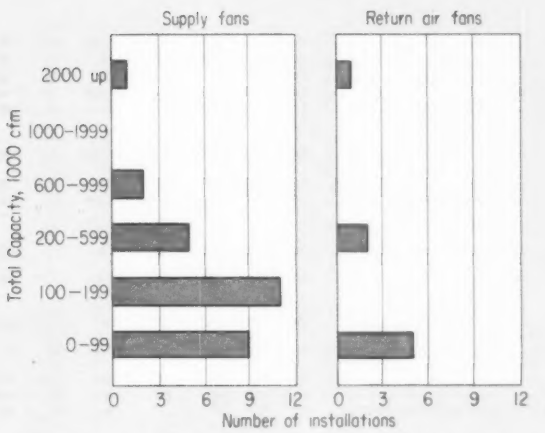
HEAVY USE of centrifugals reflects survey's minimum size of 150 tons. Absorption units find wider use over reciprocating

WATER TREATMENT



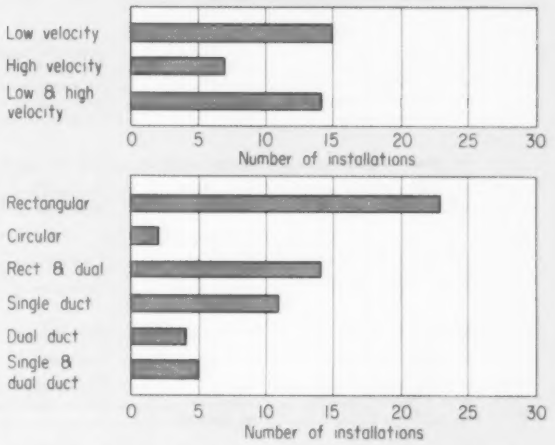
DO-IT-YOURSELF water treatment maintains a large lead over service contracts. Only ten percent reported no treatment at all

FAN SIZES



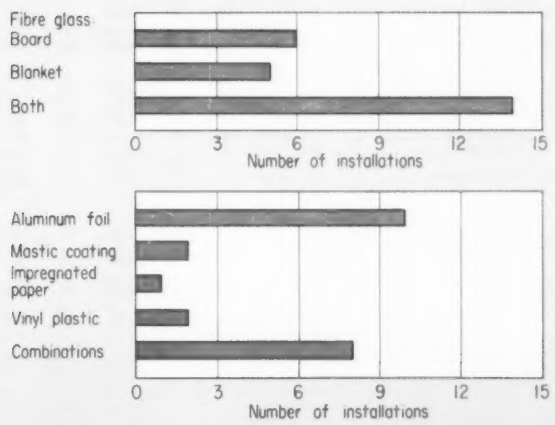
PRESSURIZED SYSTEMS (supply fan only) show trend away from balanced draft produced by use of supply and return air fans

DUCT SYSTEM



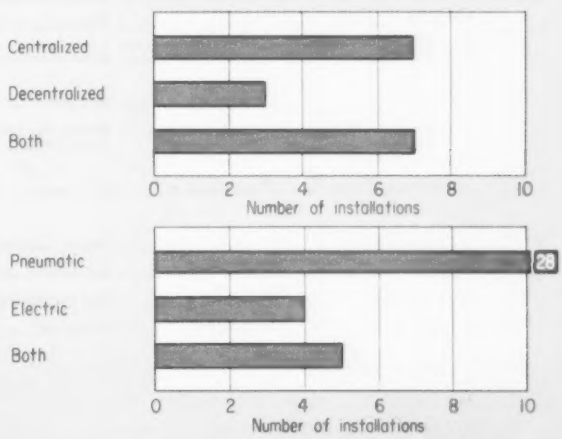
LOW VELOCITY is twice as prevalent as high, with combined systems also popular. Rectangular ducts are frequent air carriers

INSULATION — VAPOR SEAL



FIBER GLASS board-blanket combination does best job for over half installations. Aluminum foil has proved popular vapor seal

CONTROLS: LOCATION — TYPE



CENTRAL CONTROL BOARDS, alone or combined with local controls, form overwhelming choice as does pneumatic actuation

1959 survey of commercial, industrial

Each listing covers 3 pages. Project number helps you track a specific installation after you turn facing page

Project No.	Company	Location	Consulting Engineer	Contractor	New or Existing Plant	Date of initial operation	SYSTEM: Total cooling load, tons	SYSTEM: Conditioned space, area, 1000 sq ft	SYSTEM: System type	SYSTEM: Manufacturer	SYSTEM: Installed in
1	Chase Manhattan Bank Bldg	New York, N Y	Jaros, Baum & Bolles	Raisler Corp - Kerby Saunders, Inc	New	.....	9400	1700	Cen,Com	CC	Ob
2	U S Government	Capitol Hill, Washington, D C	Guy B. Panero		Ex	1960	6600[2]	.....[3]	Cen	YO	Ob
3	Old Age & Survivors Insurance Bldg	Baltimore, Md	Whitman, Requardt & Assoc		New	.....	3780	1000	Cen,Com	YO	Ob
4	James E. Smith & Sons, Inc	Hopeville, Ga	Robert & Co Assoc		New	1959	2784	460	Cen,Com	CC	.....[4]
5	Pitney Bowes Inc	Stamford, Conn	Hill & Harrigan		Ex	.....	2200	700	Pkg,Cen	WE	Ip,Ob
6	Parke Davis & Co Research Labs	Ann Arbor, Mich	Skidmore, Owings & Merrill		New	1-60	2100	200	Cen,Ab	CC	Lab
7	111 West 40th Street	New York, N Y	Jaros, Baum & Bolles	Raisler Corp	New	.....	1860	500	Com	WO	Ob
8	Lockheed Navy Support, Phase II	Sunnyvale, Cal	J. H. Pomeroy & Co, Inc		New	.....	1850	518	Cen	CC	Ip,Ob
9	Jordan Marsh Co	Boston, Mass		Spencer Air Conditioning Co	Ex	7-58	550[7] 880	.....	Cen,Com	WO TR	Dpt
10	Stern Brothers	New York, N Y		Spencer Air Conditioning Co	Ex	6-59	1300	.....	Cen,Com	WO	Dpt
11	Western Electric Co, Inc	Grandview, Mo	United Engrs & Constr Inc		New	.....	1200	125	Cen,Com	WO	Ip
12	Charles Pfizer & Co, Inc	Groton, Conn	Jaros, Baum & Bolles		New	8-59	1100	155	Ab	CC	Ip
13	Standard Gravure Corp	Louisville, Ky	E. R. Ronald & Assoc		New	10-59	1100	92.6	Cen	TR	Ip,Ob
14	International Business Machines	Poughkeepsie, N Y	Seelye, Stevenson, Value & Knecht		Ex	8-59	1000	.....	Cen,Com	Var	Ip,Ob
15	Louisville Post Office	Louisville, Ky	E. R. Ronald & Assoc	J. E. Smith & Sons	Ex	.....	850	.....	Cen	TR	Ob
16	Alexanders Dept Store	Rego Park, Queens, N Y	Syska & Hennessy Inc		New	2-59	820[8]	155	Cen,Com, HP	YO	Dpt
17	Babcock & Wilcox Co	Barberton, Ohio	Byron Lind & Assoc		Ex	6-59	800	214	Cen	WO	Ob
18	Jacksonville City Hall	Jacksonville, Fla	Reynolds, Smith & Hills	Heilley & Beckwith	New	6-60	700	210	Cen,Com	CC	Ob
19	Methodist Evangelical Hospital	Louisville, Ky	E. R. Ronald & Assoc	Ward Engrg Co	New	7-60	700	130	Cen	CC	Hos
20	R. J. Reynolds Tobacco Co	Winston Salem, N C	Buensod Stacey Inc		Ex	.....	700	.....	Cen,Ab	CC	Ip
21	Brown Palace Hotel	Denver, Col	Slone & Birkle, Inc		New	4-59	600	180	Cen	CC,FR	Hotel
22	James E. Smith & Sons, Inc	Atlanta, Ga	Brewer & Mundy		New	.....	580	150	Cen,Com	TR	Ob
23	Young Towers	Denver, Col	Slone & Birkle, Inc		New	6-60	500	215	Pkg,Cen	.....	Apt
24	U. S. Appraiser's Stores Bldg	Baltimore, Md	Whitman, Requardt & Assoc		Ex	6-59	487	118	Cen	YO	Ob,Wr
25	J. C. Penney Co	Minneapolis, Minn		Spencer Air Conditioning Co	Ex	7-58	450	.....	Pkg	TR	Dpt
26	830 W. Broadway Bldg	Louisville, Ky	E. R. Ronald & Assoc		.....	8-59	430	.....	Cen	CC	Ob
27	Louisville General Hospital	Louisville, Ky	E. R. Ronald & Assoc		New	7-59	428	50	Cen	CC	Ins
28	International Business Machines	Dayton, N J	Austin Co		New	.....	420	75	Pkg,Cen	WE	Ip,Ob
29	Aeronautronics Systems, Inc	Newport Beach, Cal	Charles Luckman Assoc	Stanley Feuer	New	.....	364	85	Cen,Com	CC	Ip,Ob
30	Broadway Realty Co	New York, N Y		Hamburger & Shea Inc	New	7-59	350	91.4	Cen,Ab	CC	Ob
31	Century Bldg	Houston, Texas	I. A. Naman & Assoc		Ex	2-59	345	84	Cen,Com	CC	Ob
32	Eli Lilly	Indianapolis, Ind	Bevington, Taggart & Fowler	Baker-McHenry	New	4-59	312	.....	Cen,Com	AB	Ob
33	Veteran's Administration Hospital	Los Angeles, Cal	Charles Luckman Assoc	Western Mechanical Inc	New	.....	310	70	Cen,Com	CC	Hos
34	Old State Office Bldg	Richmond, Va		T. A. Talley & Sons	Ex	5-59	300	104	Cen,Com	TR	Ob
35	U. S. Post Office	Galveston, Texas	Bernard Johnson	Har-Con Engineering Inc	New	6-59	275	70	Cen,Com	CC	PO & Ob
36	Yale Club of N Y	New York, N Y	Guy B. Panero	Alvord & Swift	Ex	6-59	270	.....	Ab,Cen	CC	.....
37	Northern States Power Co	Minneapolis, Minn	Richard W. Evans & Assoc		Ex	8-58	260	.....	Cen,Com	TR	Ob
38	U. S. Post Office	Albuquerque, N M	Bridgers & Paxton	A. R. Nuckols	New	8-59	260	85	Cen,Com	CC	PO
39	Link-Belt Bearing Plant	Indianapolis, Indiana		Baker McHenry, Inc	New	5-59	250	.....	Cen,Com	TR	Ip,Ob
40	Little Co of Mary Hospital, Inc	Evergreen Park, Ill	Vern E. Alden Co	G. F. Connelly Co	New	11-59	250	75	Cen	CC	Hos
41	Medical Arts Bldg	Minneapolis, Minn	Richard W. Evans & Assoc	Spencer Air Conditioning Co	Ex	8-58	210	.....	Cen,Com	TR	Ob
42	Air Force Academy Hospital	Colorado Springs, Col	Skidmore, Owings & Merrill		New	6-60	200	80	Cen,Ab	CC	Hos
43	Augustana Book Concern	Rock Island, Ill	Frederiksen Engineering		New	.....	200	.....	Cen,Com	AB	Ip,Ob
44	Perkin Elmer Corp	Norwalk, Conn	Hill & Harrigan		New	.....	170	58	Pkg	WE	Ip,Ob

Ab - Absorption
Ac - Air cooled
Apt - Apartment
Cc - Circular conduit
Ce - Centrifugal
Cen - Central
Com - Compression
Csa - Chemicals self administered
Cw - Chilled water
Dd - Dual duct
Der - Direct expansion refrigerant
Df - Douglas fir
Dpt - Department store
Ex - Existing plant or equipment
HP - Heat pump
Hos - Hospital
Hv - High velocity
Ins - Institution
Ip - Industrial plant
Lab - Laboratory
Lv - Low velocity
M - Motor
Mu - Multi-stage
N - None
Ob - Office building
Pkg - Package
PO - Post office
R - Refrigerant
Rdw - Redwood
Rec - Rectangular duct
Rp - Reciprocating
Sc - Service contract
Sd - Single duct
Ss - Single stage
T - Turbine Drive
Var - Various, Varies
Wc - Water cooled
Wr - Warehouse

1 - 1000 gpm
2 - 8800 tons installed, 1957; 6600 tons, 1959; total tonnage, 15,400
3 - Central chiller house supplies chilled water to all leg. & jud. buildings on Capitol Hill
4 - Airport terminal
5 - Dry bulb

and institutional air conditioning

NEW COMPRESSORS								AIR COOLING COILS			CONDENSER		COOLING TOWERS								
																COOLING RANGE					
No. new units	Manufacturer	Type	Rpm	Refrigerant	Drive	Drive hp, each compressor	Drive mfr	H_2O to coils, F	H_2O from coils, F	Cooling medium	Type	Manufacturer	No. of towers	Manufacturer	Capacity, gpm	From, F	To, F	At F. wet bulb	Fill	Cooling water treatment	Ductwork type	Project No.
4	CC	Ce	.....	R11 R500	T	2500	TE	44	60	Cw	Wc	CC	3	MC	27.4[1]	107.6	85.5	78	Rdw	Csa	Rec,Cc Lv,Hv,Sd	1
4	YO	Ce	5000	R-12	M	2-2500 2-1250	EM	40	52	Cw	Wc	YO	3	.....	.....	95	85	79	Rdw	Csa	N	2
3	YO	Ce	5950	R-12	M	1500	ME	43	53.4	Cw	Wc	YO	1	MC	11.3[1]	97	87	80	Rdw	N	Rec,Lv, Cc,Hv	3
3	CC	Ce	3600	.....	M	850	.....	44	54	Cw	Wc	CC	1	CC	8340	95	85	95[5]	Rdw	.....	Rec	4
70 Pkg[6]	WE	Rp	.....	.....	.....	.....	WE	.....	.....	Der	Wc	WE	6	MC	2-900	95	85	78	Rdw	.....	Rec,Lv	5
N	.....	.....	.....	.....	.....	.....	.....	44	57	Cw	Wc	CC	1	MC	7350	104	85	75	Rdw	Csa	Rec,Lv Cc,Hv,Sd	6
3	WO	1 Rp 2 Ce	622 4840 3820	R-11	M T T	150 WO 1680	EL WO WO	42	54	Cw	Wc	WO	2	PC	5580	108.8	88	78	Rdw	Csa	Rec,Lv Cc,Hv Sd,Dd	7
1	CC	Mu,SS	.....	R12	M	1750	.....	45	55	Cw	Wc	CC	1	JT	5500	90	80	91[5]	Rdw	Csa	Rec,Lv,Sd	8
3	1 WO 2 TR	Ce	3600	R11	3M	1-500 2-400	LA	42	54	Cw	Wc	WO,TR	2	MC	1650 2650	95	85	78	Rdw	Csa	Rec,Lv	9
2	WO	Ce	4950	R11	T	650	WO	42	54	Cw	Wc	WO	1	MC	3900	105	85	95[5]	Rdw	Csa	Rec,Lv	10
2	WO	Ce	.....	R11	M	540	EM	44	60	Cw	Wc	WO	1	MC	4000	95	85	77	Rdw	Sc	Rec,Lv,Sd	11
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Cw	Ac	.....	1	MC	.....	.....	.....	.....	Rdw	Sc	Hv	12
2	TR	Ce	3600	R11	M	480	.....	44	54	Cw	Wc	TR	2	.....	3300	95	85	78	Rdw	.....	Rec,Lv,Hv	13
1	YO	Ce	5720	R12	M	1000	WE	.....	.....	.....	Wc	YO	Ex	.....	.....	.....	.....	.....	.....	.....	Ex	14
2	TR	Ce,Mu	3600	R11	M	420	LA	45	55	Cw	Wc	TR	1	MC	2550	95	85	75	Rdw	Csa	Rec,Lv	15
4	YO	2-Ce 2-Rp	.....	R12	M	300 150	WE	42[9]	54	Cw	Ac	YO	N	.....	.....	.....	.....	.....	.....	.....	.....	16
2	WO	Ce,Mu	3550		M	350	LA	45	.....	Cw	Wc	WO	2	MC	2280	95	85	.....	Rdw	.....	Rec,Cc,Hv	17
2	CC	Ce	3550	R113	.....	710[10]	.....	42	52	Cw	Wc	CC	3	MC	2250	102	85	79	Rdw	Csa	Lv,Hv Sd,Dd	18
2	CC	Ce	3550	R113	M	355	.....	42	52	Cw	Wc	CC	1	MC	2100	95	85	95[5]	Rdw	.....	Rec,Cc Lv,Hv Dd,Sd	19
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	MC	2500	102	85	78	Rdw	.....	Rec	20
2	FR	Rp	800	R12	M	600[10]	LA	42	52	Cw	Wc	FR,CC	1	MC	1800	95	78	95[5]	Rdw	Csa	Cc,Hv,Sd	21
2	CC	Rp	1200	R12																		
3	TR	2-Ce 1-Rp	3600	R113	M	2-250 1-20	AC	44	54	Cw,Der	Wc	TR	2	MC	1764	95	85	95[5]	Rdw	.....	Rec,Hv	22
1	.....	Ce,Ss	.....	.....	M	.....	.....	42	50	Cw[11]	Wc	.....	N	.....	.....	.....	.....	.....	.....	.....	.....	23
2	YO	Ce,Ss	9200	R11	M	300	AC	43	54	Cw	Wc	YO	1	MC	1461	97	87	80	Rdw	Sc	Rec,Lv,Sd	24
23[13]	TR	Rp,Ss	1750	R12	M	Var	.....	.....	.....	Der	Wc	TR	1	MC	1350	95	85	75	Rdw	.....	Rec,Lv	25
2	CC	Ce	3550	.....	M	200	.....	45	54	Cw	Wc	CC	1	P	1220	95	85	78	Rdw	.....	Rec,Lv	26
1	CC	Ce	3500	R113	M	400	.....	45	55	Cw	Wc	CC	1	MC	1300	95	85	78	Rdw	Sc	Rec,Cc Hv,Dd	27
1	TR	Ce,Mu	3600	.....	M	.....	WE	40	50	Cw	Wc	TR	1	MC	1205	95	85	75	Rdw	Csa	Rec,Hv, Sd,Dd	28
1	CC	Ce	3600	R113	M	350	.....	45	57	Cw	Wc	CC	1	BAC	1090	95	85	70	Steel	Csa	.....	29
.....	.....	.....	.....	.....	.....	.....	.....	45	55	Cw	Wc	CC	1	PC	1225	102	85	78	Rdw	Sc	Rec,Lv,Sd	30
1	CC	Ce	3500	R11	M	350	.....	42	54	Cw	Wc	CC	1	MC	1500	93.5	86	80	Rdw	Csa	.....	31
2	AB	Ce	3600	.....	M	.....	LA	45	55	Cw	Wc	AB	1	MC	1000	95	85	80	Rdw	.....	Rec,Cc Lv,Hv,Dd	32
1	CC	Ce	3600	R113	M	300	.....	44	54	Cw	Wc	CC	1	MC	900	95	85	72	Rdw	Csa	.....	33
1	TR	Ce,Mu	3600	R11	M	300	RM	44	59	Cw	Wc	TR	1	MC	900	95	85	78	Rdw	Sc	Rec,Lv,Sd	34
1	CC	Ce	3600	R11	M	300	.....	46	56	Cw	Wc	CC	1	SM	1100	93.5	86	80	Rdw	Csa	Rec,Lv	35
.....	.....	.....	.....	.....	.....	.....	.....	42	52	Cw	.....	.....	2	BAC	900	95	85	78	Steel	Csa	Rec,Cc Lv,Hv	36
3	TR	Rp,Ss	1750	R12	3M	250[10]	HEM	.....	.....	Der	Wc	TR	3	MC	750[10]	95	85	75	Rdw	.....	Var	37
1	CC	Ce	3550	R113	M	250	.....	45	53	.....	Wc	CC	1	MC	788	95	85	.....	Dl	Sc	Cc,Hv,Dd	38
2	TR	Ce	.....	R12	M	.....	.....	45	55	Cw	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Rec	39
1	CC	Ce,Mu	3600	R113	M	250	.....	45	57	Cw	Wc	CC	1	CC	750	95	85	95[5]	Rdw	N	Rec,Cc Lv,Hv Dd,Sd	40
1	TR	Ce	3600	R11	M	185	.....	40	64	Cw[12]	Wc	TR	N	.....	.....	.....	.....	.....	.....	.....	Rec,Cc Lv,Hv	41
.....	.....	.....	.....	.....	.....	.....	.....	42	52	Cw	Wc	CC	1	.....	650	102	80	60	Rdw	Csa	Rec,Cc Lv,Hv,Sc	42
1	AB	.....	.....	.....	.....	200	.....	44	54	Cw	.....	.....	1	MC	605	105	95	95[10]	Rdw	.....	Rec,Hv, Lv,Sc	43
12[13]	WE	Rp	.....	.....	M	.....	.....	.....	.....	Der	Wc	WE	1	MC	500	95	85	78	Rdw	.....	Rec,Lv	44

6 - Plus 19 built up units
7 - Total, 1430 tons
8 - Heating, 3350 MBtu/hr
9 - H_2O to coils is 115 F at zero F outside air
10 - Total
11 - 55 F well water to condenser
12 - Chilled well water
13 - Packaged units

AB - American Blower Corp
AC - Allis-Chalmers Mfg Co
BAC - Baltimore Aircoil Co, Inc
BC - Barber Coleman Co, Controls Div
BF - Buffalo Forge Co
BM - Brook Motor Co
CC - Carrier Corp
CE - Century Electric Co
CHB - Chicago Blower Corp
CW - Crocker Wheeler Div
EL - Elliott Co

EM - Electric Machinery Mfg Co
FR - Frick Co
GB - Gustin-Bacon Mfg Co
GE - General Electric Co
HEM - Howell Electric Motors Co
JM - Johns-Manville
JS - Johnson Service Co
JT - Johnson Tank & Tower Co
K - The Korfund Co, Inc
LA - The Louis Allis Co

LOF - Libbey-Owens-Ford Glass Co
MC - The Marley Co
MCC - Mario Coil Co
McQ - McQuay, Inc
ME - Marathon Electric Mfg Co
MH - Minneapolis-Honeywell Regulator Co
MU - Mundet Cork Corp, Insulation Div
P - J F Pritchard & Co
PC - Phillips Cooling Tower Co

PE - The Peerless Electric Co
PR - The Powers Regulator Co
RA - Richmond Asbestos Co
RK - Robert A Keasby Co
RM - Reliance Electric & Engineering Co
SM - A O Smith Corp
SW - Sturtevant Div, Westinghouse Electric Corp
TE - Terry Steam Turbine Co

1959 air-conditioning survey continued

Compiled by:
J. W. Follansbee, Assistant Editor

Project No.	AIR HANDLING EQUIPMENT														INSULATION			CONTROLS			MOUNTINGS		
	SUPPLY FANS							RETURN FANS															
	Number	Total capacity 1000 cfm	Rpm	Manufacturer	Total drive hp	Drive rpm	Manufacturer	Number	Total capacity 1000 cfm	Rpm	Manufacturer	Total drive hp	Drive rpm	Manufacturer	Type	Manufacturer	Vapor seal	Manufacturer	Type	Location	Manufacturer	Type	Sound absorbant
1	51	2000	.....	SW	2550	1200 1800	WE	80[15]	2350	.....	SW	825	1200 1800	WE	Fg,Mg Cork	RK,RA	Pre,Al	MH	Tp,H, Pn,E	CS	VM	Sp,Ris	.....
2	.....[16]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3	34	828	440- 2085	.....	7.5-40[17]	1200 1800	GE	N	.....	.....	.....	.....	.....	.....	Fg[18]	ACS	Imp	BC	Tp,E	.....	VE	Ris, Cork	Id, Imr
4	71	.....	.....	MCC	.....	.....	.....	73	.....	.....	AB	.....	.....	.....	.....	AR	Mc,Al	JS	Tp,H,Pn	.....	.....	Ris	.....
5	17	8-34[17]	.....	AB	.....	.....	.....	N	.....	.....	.....	.....	.....	.....	.....	.....	.....	JS	Tp,H,Pn	.....	.....	.....	.....
6	32	450	650[19]	AB	425	1750	HEM	37	325	700[19]	AB	300	1750	HEM	Bo,Bl	OC	Pre,Doj Vp	MH	Pn	Ng,CS	K	Sp,Ris	Id, Imr
7	.....	472	350- 1000	SW	668	1200 1800	WE	.....[15]	573	350- 1000	SW	163	1200 1800	WE	Bl,Bo	RA	Al,Doj[20]	MH	Tp,H Pn,E	Ng,CS	VE	Sp,Ris	Id
8	22	45[19]	Var	UFC	25[19]	1800	AC	N	.....	.....	.....	.....	.....	.....	Fg	OC	Al	MH	Tp,H,El	CS	.....	Ris	Imr
9	39	425	Var	McG	2-7.5[17]	1750	LA	N	.....	.....	.....	.....	.....	.....	Bl,Bo	.....	.....	JS	Tp,Pn	.....	.....	Ris	Id
10	21	270	Var	WO	3-7.5[17]	1750	.....	1	24	.....	SW	7.5	1750	AC	Bl,Bo	.....	.....	JS	Tp,Pn	.....	VM	Sp,Ris Cork	.....
11	10	30[17]	.....	AB	40[17]	.....	.....	N	.....	.....	.....	.....	.....	.....	Bo	.....	Pre,Al	JS	Tp,Pn	.....	.....	.....	.....
12	18	350	Var	BF	.....	.....	.....	60	.....	Var	BF	.....	.....	.....	.....	.....	.....	MH	.....	.....	.....	Sp,Ris	.....
13	9	165	.....	.....	.....	.....	AC	N	.....	.....	.....	.....	.....	.....	Bl,Bo	OC	Doj,Al,Imp	MH	Pn	.....	VE	Sp	.....
14	Ex	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Ex	.....	.....	Ex	.....	.....	.....	.....	.....
15	59	.....	.....	MCC	.....	.....	.....	N	.....	.....	.....	.....	.....	.....	Bl,Bo	OC	Pre,Mc,Al	MH	Tp,Pn	.....	.....	Ris	Id
16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
17	4	148	1150	ARC	50-75[17]	1750	AC	N	.....	.....	.....	.....	.....	.....	Fg	.....	Al	MH	Tp,E	Ng	WO	Ris	Id
18	8	150	800	CC	250	1750	AC	18	90	800	BF	50	1750	AC	Bo	MU	Pre	MH	T,H, Pn,E	Ng,CS	VE	Sp	Id
19	4	68.3	.....	CHB	150	Var	AC	N	.....	.....	.....	.....	.....	.....	Bl,Bo	JM,AR	Pre,Mc, Imp	MH	T,H,Pn E,El	CS	VE	Sp,Ris	Id
20	8	160	.....	AB	.....	.....	AC	N	.....	.....	.....	.....	.....	.....	.....	.....	.....	TI	Tp,H,Pn	.....	.....	.....	.....
21	6	120	1400	CC	120	1750	LA	3	60	900	AB	60	1750	LA	Bl	GB	Al	JS	Tp,H,Pn	CS	K	Sp	Id
22	376	.....	.....	.....	.....	.....	.....	N	.....	.....	.....	.....	.....	.....	Fg	AR	Mc	JS	T,H,Pn	.....	.....	Ris	.....
23	2	13	.....	.....	8	1750	.....	.....	.....	.....	.....	.....	.....	.....	Bl	.....	Pre	JS	Pn	.....	.....	Ris	.....
24	2	43	600	PE	30	1150	PE	N	.....	.....	.....	.....	.....	.....	Bo	OC	Pre, Imp	JS	Tp,Pn	Ng	VE	Ris	Id, Imr
25	23	180	.....	TR	.....	1750	.....	N	.....	.....	.....	.....	.....	.....	Bl,Bo	.....	.....	BC	Tp,E	.....	.....	.....	.....
26	14	130	.....	CC	.....	.....	.....	N	.....	.....	.....	.....	.....	.....	Bl,Bo	OC	Al, Imp	JS	Pn	.....	.....	.....	.....
27	3	70	.....	.....	.....	.....	AC	N	.....	.....	.....	.....	.....	.....	Bl,Bo	OC	Doj,Al, Imp	MH	Pn	.....	K	Sp,Ris	Id
28	9	Var	3-700	SW	0.5-10[17]	1725	AC	N	.....	.....	.....	.....	.....	.....	Fg	Cus	Doj	MH	Tp,H,Pn	Ng,CS	.....	Sp	.....
29	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
30	11	119	Var	CC	143	Var	.....	N	.....	.....	.....	.....	.....	.....	.....	JM	.....	JS	Tp,Pn	.....	VM	Ris	.....
31	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
32	6	4-16 2-30	617 1050	TR	7.5[17] 40[17]	1800	.....	N	.....	.....	.....	.....	.....	.....	.....	JM	.....	MH	Pn	.....	.....	Sp,Ris	Id, Imr
33	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
34	34	.....	Var	MCC	.....	Var	BM	N	.....	.....	.....	.....	.....	.....	Bo	OC	Mc	MH	Tp,Pn	CS	VE	Ris	Id, Imr
35	16	85	Var	MCC	Var	1750	CE	N	.....	.....	.....	.....	.....	.....	Bo	THI	Doj,Mc, Imp	MH	Tp,H,Pn	Ng,CS	VM	Ris	Id
36	3	23	.....	CC	30	.....	.....	2	.....	.....	CC	.....	.....	.....	Bl	LOF	Al	PR	Tp,H,Pn	Ng	.....	.....	.....
37	5	88	.....	BF	90	1750	AC	N	.....	.....	.....	.....	.....	.....	Bo	.....	Al	JS	Tp,Pn	.....	.....	Sp	Id, Imr
38	5	112	.....	CC	63	.....	.....	3	.....	.....	AB	15	1800	.....	Bl	.....	Al	MH	Tp,Pn	Ng,CS	K	Ris	Id
39	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	AR	.....	JS	Tp,H,Pn	.....	.....	.....	.....
40	3	42.6	Var	CHB	80	1750	CW	3	38.1	Var	CC	16	1750	CW	Bl	GB	Doj,Al	JS	Tp,H,Pn	CS	VM,VE	Sp,Ris	Id
41	2	.....	.....	BF	.....	1750	AC	N	.....	.....	.....	.....	.....	.....	Bl,Bo	.....	.....	JS	Tp,Pn	.....	.....	Ris	.....
42	7	110	700	.....	120	1725	.....	9	65	.....	.....	25	1725	.....	Bl,Bo	.....	Pre	.....	Tp,H Pn,El	Ng,CS	.....	Ris	Id, Imr
43	3	.....	.....	TR,AB	.....	.....	.....	N	.....	.....	.....	.....	.....	.....	Bl,Bo	.....	Vp	MH	Pn	.....	.....	.....	.....
44	N	.....	.....	.....	.....	.....	.....	N	.....	.....	.....	.....	.....	.....	.....	.....	.....	MH	Tp,Pn	.....	.....	.....	.....

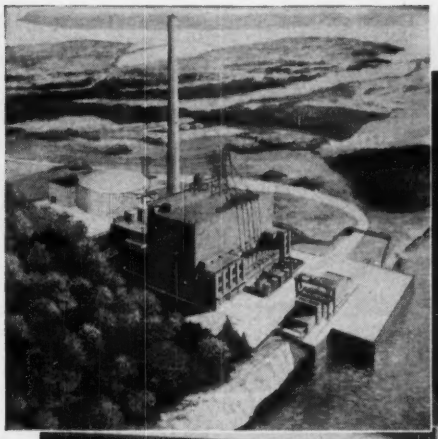
THI - Thorpe Insulators
TI - Taylor Instrument Companies
TR - Trane Mfg Inc
UFC - Utility Fan Corp
VE - The Vibration Eliminator Co
VM - Vibration Mountings Inc
WE - Westinghouse Electric Corp
WO - Worthington Corp
YO - York Div

Al - Aluminum
Bl - Blanket
Bo - Board
Cork - Cork
CS - Central scanning
Cus - Custom made
Doj - Done on the job
E - Electric
El - Electronic

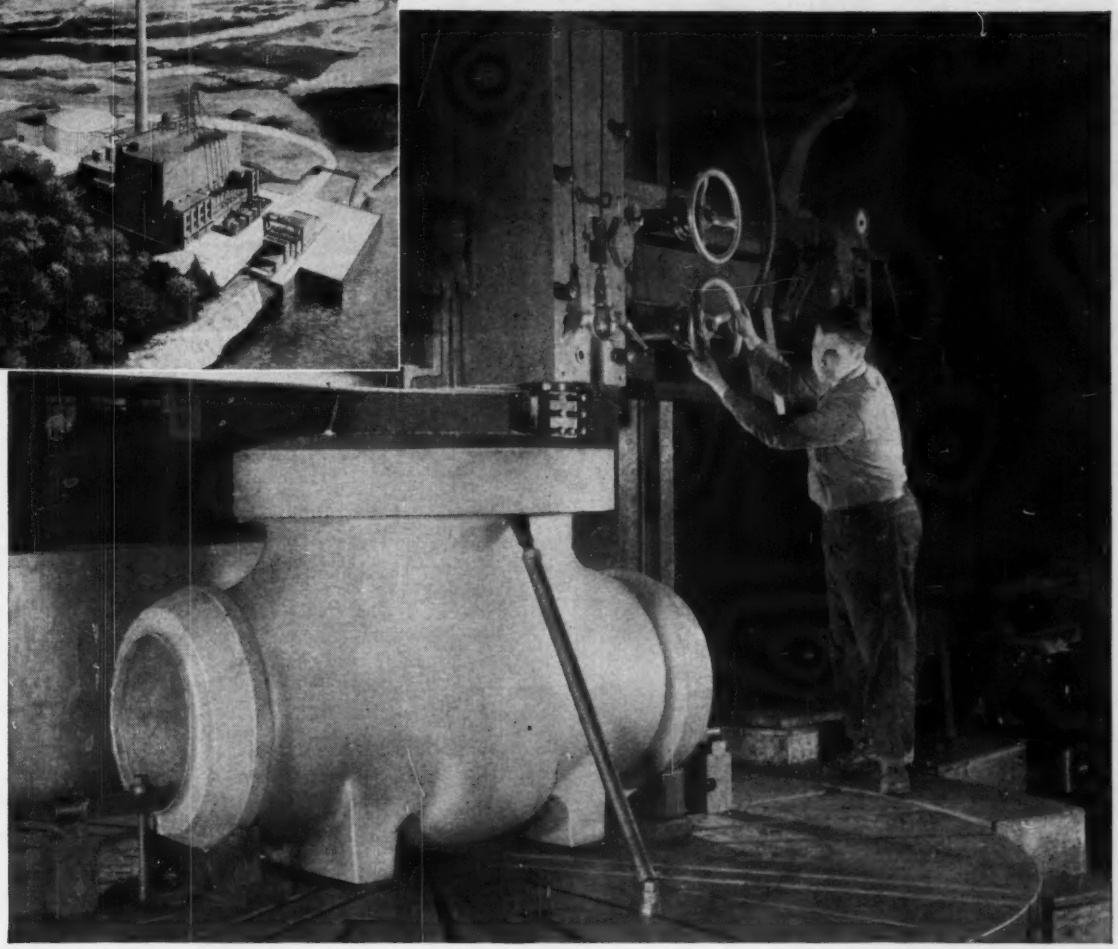
Ex - Existing
Fg - Fibre glass
H - Humidity
Id - Inside duct
Imp - Impregnated paper
Imr - Inside machinery room
Mc - Mastic coating
Mg - Magnesia

Ng - At or near grill
Pre - Presealed
Pn - Pneumatic
Ris - Rubber-in-shear
Sp - Springs
Tp - Temperature
Vp - Vinyl plastic
14 - Total

15 - Plus exhaust & transfer fans
16 - Supplies chilled water only to Capitol Hill Bldgs air units
17 - Each
18 - Exposed work, board; concealed work, blanket
19 - Average fan hp or rpm
20 - Also impregnated canvas



Indian Point nuclear power plant as it will look when completed for the Consolidated Edison Company of New York, Inc.



Machining 5½-ton Type 304 stainless steel body casting for one of the Indian Point valves. Completed valve will weigh approximately 12 tons. Crane maintains complete facilities for making nuclear valves—including the most advanced scientific methods for rigorous inspection, and testing on hot and cold loops.

8 Giant Crane Valves for Indian Point Atomic Plant

Crane is selected again! Our big Chicago works, with facilities for making valves from the smallest to the largest, is taking in stride an order for eight 24-inch stainless steel gate valves—the largest of their kind ever built.

These valves are for installation on the four main coolant loops serving the pressurized water reactor at Consolidated Edison Company's Indian Point nuclear power plant in Westchester County, New York.

Crane offers you the experience, engineering and metallurgical knowledge, manufacturing skill and plant facilities that have produced valves for such important atomic power projects as the Navy's fleet of nuclear-powered submarines and surface warships . . . the nuclear cargo ship *N/S Savannah* . . . the nuclear power plant at Shippingport, Pa. . . . and the EBWR at Argonne National Laboratory.

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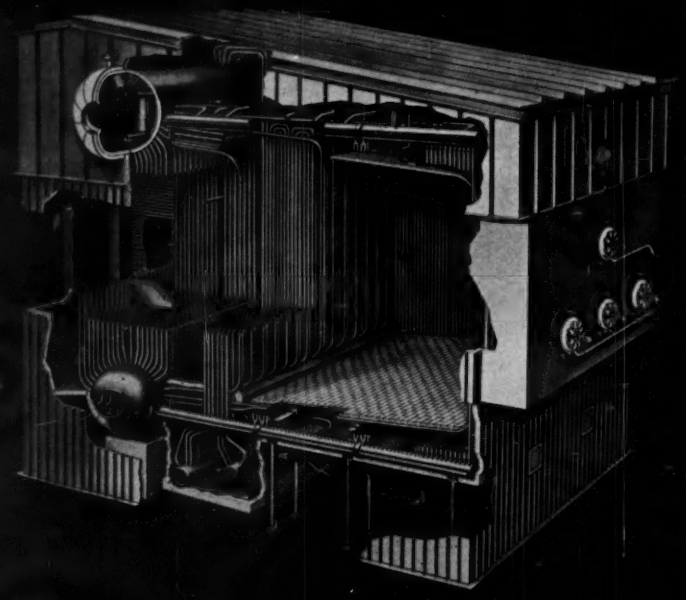
In Canada: Crane, Limited, 1170 Beaver Hall Square, Montreal, Que.

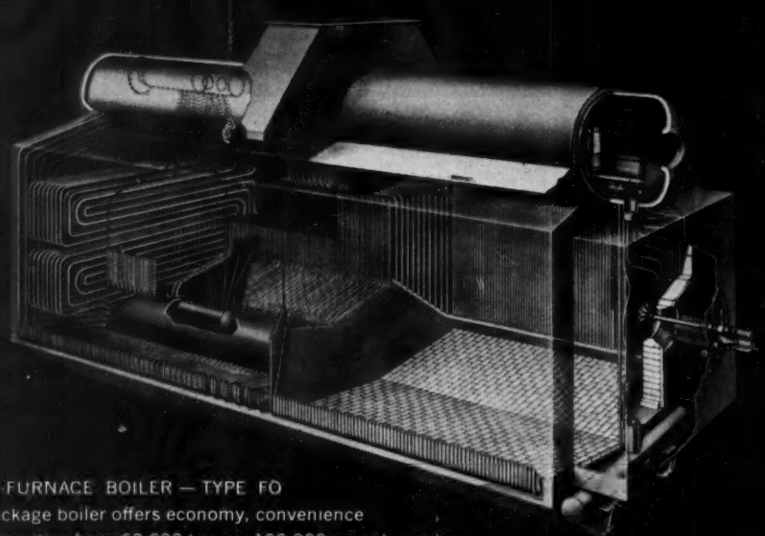
For more facts circle 830 on Reader Service card, p 227

B&W INTEGRAL-FURNACE BOILERS

. . . range in size from shop assembled "package" units (5,000 to 100,000 lb hr) to field erected units for capacities up to 400,000 lb hr.

B&W INTEGRAL-FURNACE BOILER, TYPE PFI—The PFI, B&W's new Integral-Furnace Boiler, produces steam in the general range of 80,000 to 400,000 pounds per hour. Oil or gas, or a combination of both, can be used as fuel. In power, process or heating applications, the pressure fired PFI assures clean, dependable steam over a wide load range. The drainable superheater, at left center, permits the draining of water after a shut down, facilitating easy storage and simple, safe start-up. Generous tube spacing prevents ash or slag plugging of the superheater. The burners at extreme right are centralized for easy observation and adjustment, while the integral combustion air duct at the top of the unit saves space.





B&W INTEGRAL-FURNACE BOILER — TYPE FO — B&W's new package boiler offers economy, convenience and quality at capacities from 60,000 to over 100,000 pounds per hour. A natural circulation boiler, the FO combines the advantages of the package boiler with the proved reliability of B&W Integral-Furnace design. The FO Boiler has a completely water-cooled furnace of ample volume, and is designed to provide steam at pressures from 250 to 775 psi at temperatures up to 750 F.

STEAM FOR INDUSTRY

...from Babcock & Wilcox Integral-Furnace® Boilers.

Steam for industry can be produced most efficiently with units designed and constructed by Babcock & Wilcox, the nation's most experienced company in its field.

B&W's engineering progress provides a range of steam capacities, pressures and temperatures that can solve your particular requirements. Modern B&W Integral-Furnace Boilers embody the operation, design and maintenance features that assure efficiency, economy and availability of clean, dry steam for any use.

For new plant installation, expansion of present facilities or replacement of obsolete units, ask B&W's engineering staff for their recommendations. They'll be happy to help you work out the best solution. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

G-957-1B

B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

For more facts circle 831 on Reader Service card, p 227

. . . "Frictionless" design gives Flexotrol* longest life, stability and accuracy of any displacement level controller

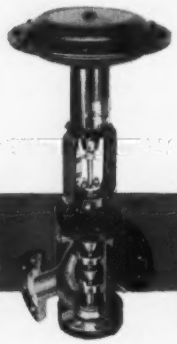
By avoiding knife edges, bearings and associated pressure-tight mechanical fittings, K & M has achieved almost frictionless operation in the *Flexotrol* Displacement-Type Liquid Level Controller. As a result, errors due to friction, distortion and hysteresis are practically nil.

Actuation is accomplished through a torque element which directly transfers displacer movement to the controller. There are no intermediate levers. Because the rotation of the tube is limited (4°) and because the whole assembly is constructed of high-durability materials, the torque system has remarkable fatigue resistance. Tests in excess of five million operating cycles have produced no detrimental fatigue effect.

The controller unit utilizes conventional 3-15 psi signal air pressure, has a 0-150% adjustable proportional band, may be direct-, reverse- or snap-acting without parts change. The *Flexotrol* Level Controller can also be converted to a transmitter-controller combination. Automatic reset and rate response are optionally available.

Full details are given in Bulletin 456-1. A copy is yours for the asking.

*Flexotrol is a trade-name of Kieley & Mueller, Inc.



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These new Cyclo-trells can be built to fit any specific job. Available in Types C-10 (10″ diameter), C-24 (24″ diameter), IC (involute Cyclo-trell), ICL (involute Cyclo-trell, lined) and C-24-L (24″ lined). Also available: a new hopper discharge valve.

Write now for your copy of new Bulletin 300 which gives details and illustrations of the new Cyclo-trells and hopper discharge valve.

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RC203

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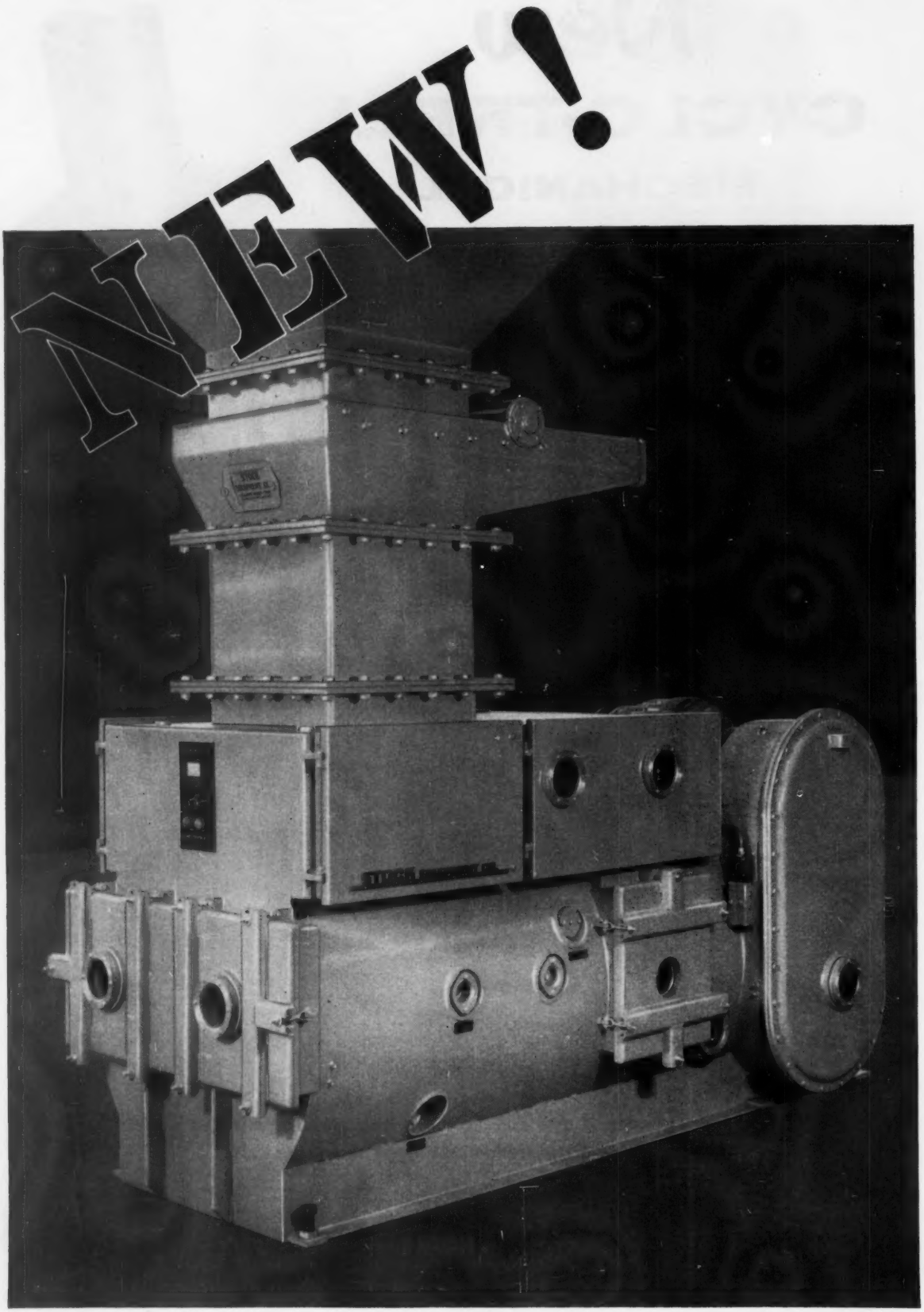
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a complete line of

GRAVIMETRIC FEEDERS

S-E-Co. Gravimetric Feeders assure you of reliable coal feeding to your pulverizers or cyclone burners. The width of coal stream from inlet to outlet is a full, uninterrupted 24". Wet, sticky coal is handled readily with no trouble. In addition to reliability, S-E-Co. Gravimetric Feeders offer you gravimetric control of energy input. Coal feed rate to each pulverizer or cyclone is controlled by weight, permitting close regulation of fuel-air ratio and accurate distribution among burners. The rate of coal feed in pounds per hour is indicated on your boiler panel. A complete line of S-E-Co. Gravimetric Feeders is available to meet your type and capacity requirements.

Include S-E-Co. Gravimetric Feeders in your next boiler specification.

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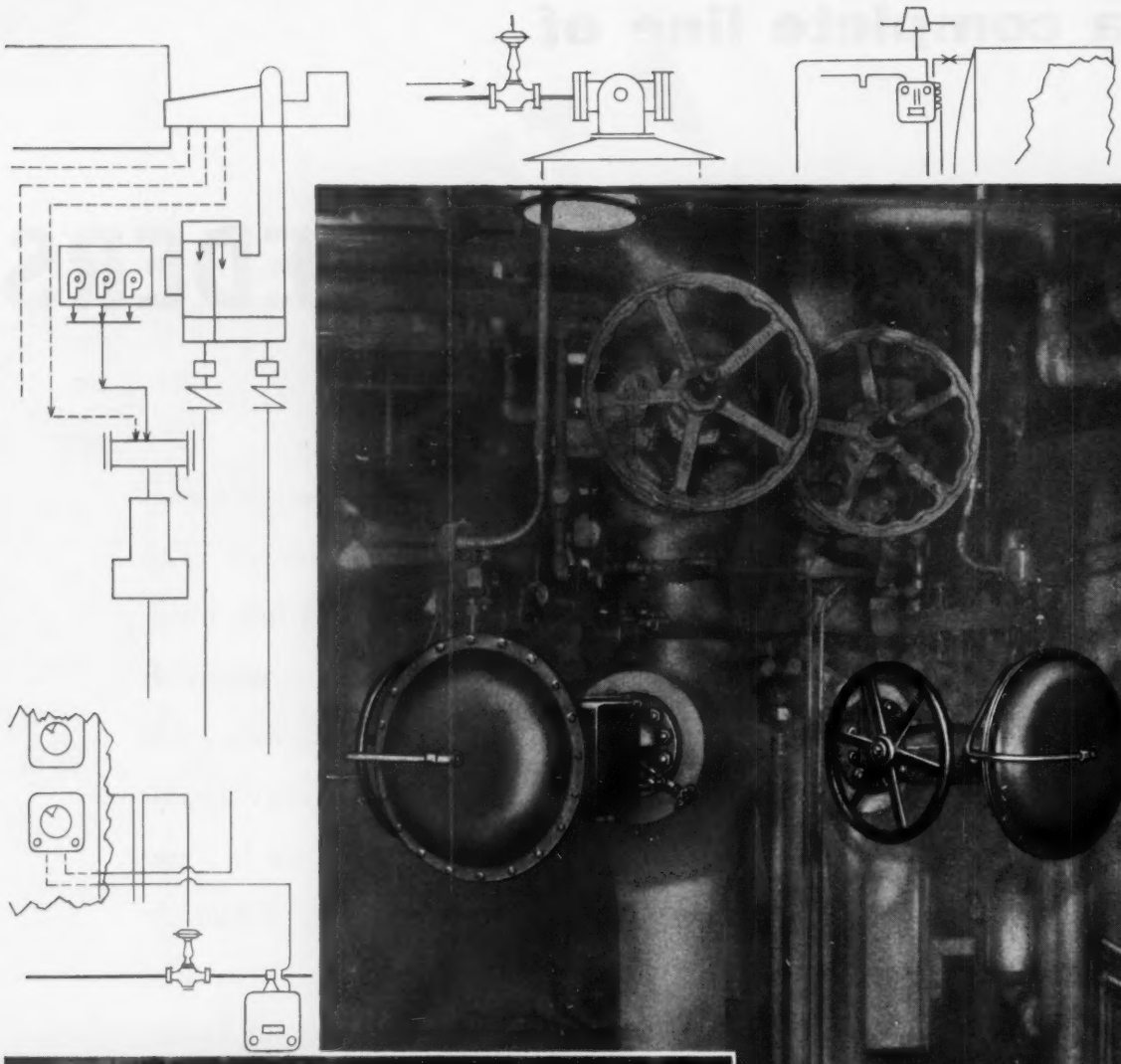
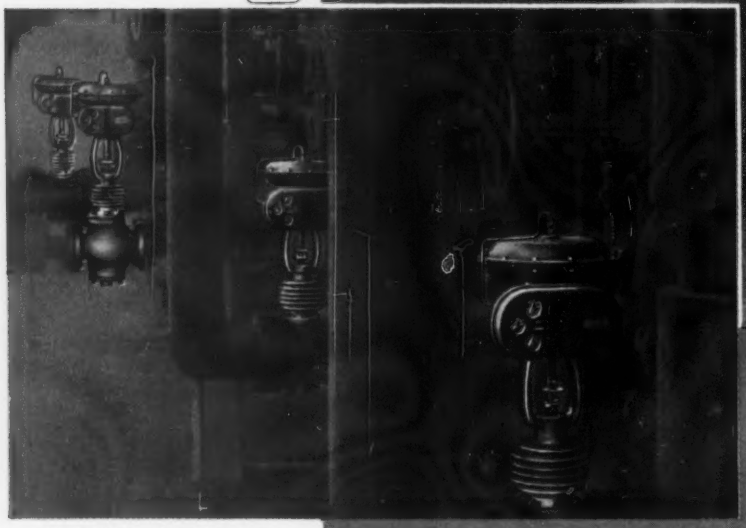


Boiler Feed Water Control Valves Installed at the Shippingport, Pa. Atomic Power Plant.



Control Valves for Turbine Driven Boiler Feed Pumps

VERSATILITY OF STANDARD MASONEILAN CONTROLS

Key to Dependability and Economy in Power Plant Operation

The wide variety available in standard Masoneilan Controls, plus adaptability to special conditions (often through interchangeability of unit subassemblies), simplifies the selection and maintenance problems of engineers concerned with power generation and power services. For example: —

CONTROL VALVES . . . body and trim types are designed to permit a maximum of interchangeability; full or reduced capacity; with percentage or linear characteristics as required. Advanced design butterfly types are also available with wide choice of actuators, and soft and angle seating.

LEVEL CONTROLLERS . . . units for proportional, proportional-reset, differential-gap control, or for pneumatic transmission, or combinations of any two of these in a single case. Also a complete variety of vessel mounting types.

PNEUMATIC CONTROLLERS . . . non-indicating, indicating and recording instruments for controlling pressure, temperature and flow. Features include unit sub-assemblies for wide choice of function and variety of action.

TRANSMITTERS . . . for pressure, temperature, flow and level, providing accurate remote measurement and pneumatic transmission; featuring a number of exclusive advantages.

Versatility designed into standard Masoneilan products helps to achieve accurate, dependable control with simplicity and economy. It can be profitable to you.

For details call a Mason-Neilan representative, or write:

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Division of Worthington Corporation

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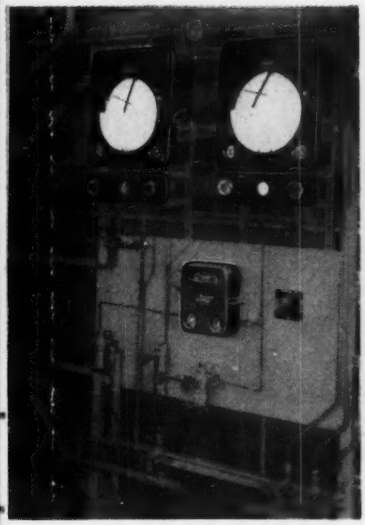
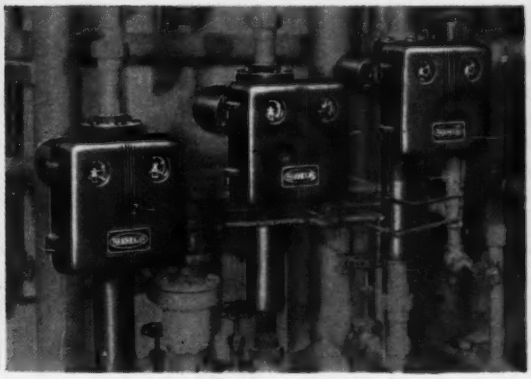


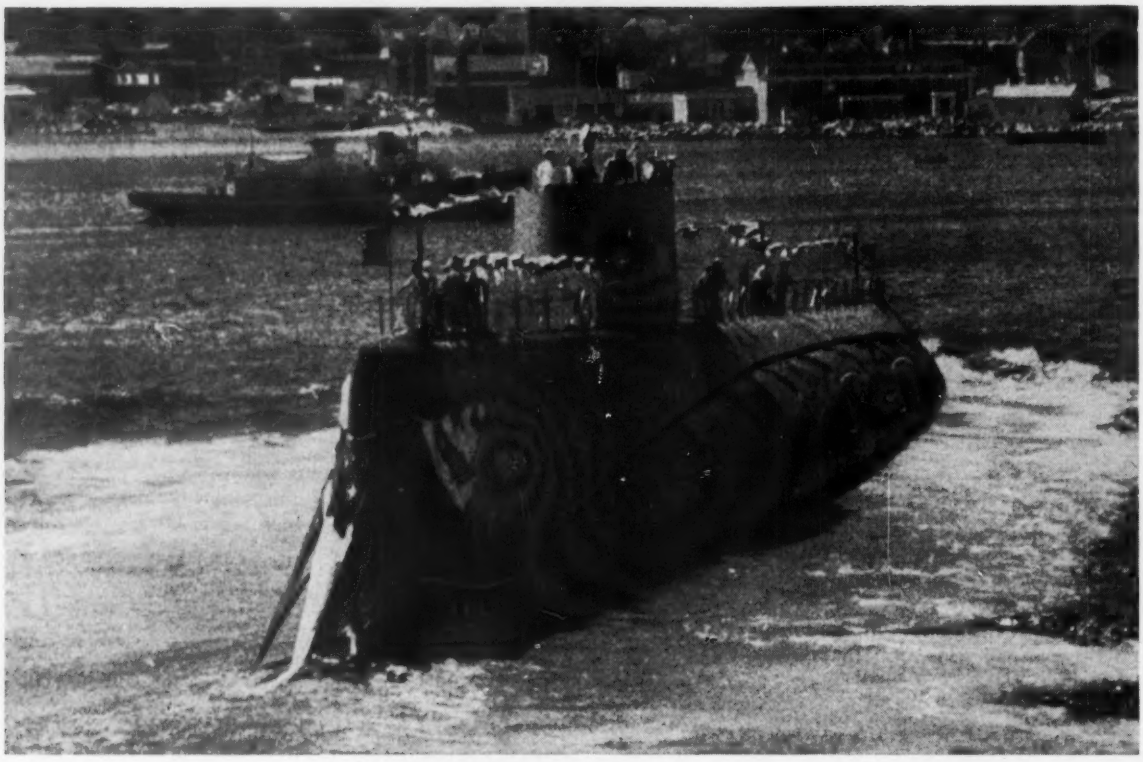
Pressure and Temperature Controllers



Level Controllers on Condenser Hotwell

Control Valve in Feedwater Starting Service

For more facts circle 835 on Reader Service card, p 227



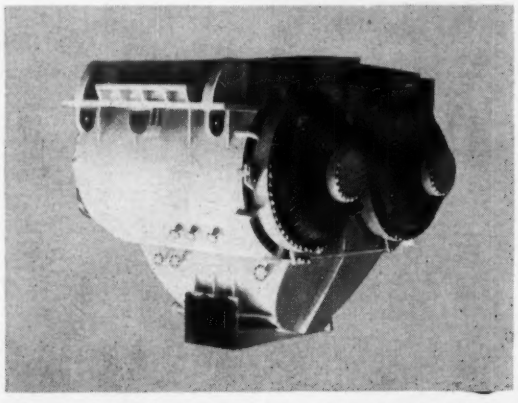
Triton, Navy's Largest Nuclear Sub, Uses Bridgeport Condenser Tubes

Launched in August, 1958, the U.S.S. *Triton* is the biggest, most powerful submarine ever built. With a length of 447 ft. and a displacement of 5,900 tons, *Triton* boasts, among other things, of two engine rooms and two reactor compartments. Built by the Electric Boat Division of General Dynamics Corporation, she is truly a major achievement in naval architecture.

Naturally, *Triton's* equipment must meet the most rigid operating requirements. Helping to fulfill these requirements are Bridgeport Cupro-Nickel condenser tubes in the Allis-Chalmers condenser and air ejector equipment.

Meeting operating demands such as *Triton's* has long been standard practice at Bridgeport. Outstanding operating records have been—and are being—achieved regularly. The experience and knowledge gained from these records can be put to your use—whenever you wish to take advantage of them.

Whatever your needs—simple retubing or other requirements—they are best served, in every respect, by Bridgeport. If you have any problem, question or plans involving heat exchanger equipment, on land or at sea, call your nearest Bridgeport Sales Office. For full details, write direct for the 162-page Bridgeport Condenser Tube Handbook. Write Department 5410.



These twin condenser units were designed and built by Allis-Chalmers. Bridgeport tubes were used throughout.

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Bridgeport 2, Connecticut • Sales Offices in Principal Cities

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Shows you why Clarage's airfoil fan tops all others where it counts...on-the-job

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Please send me Catalog 859 describing Clarage Dynafoil Fans.

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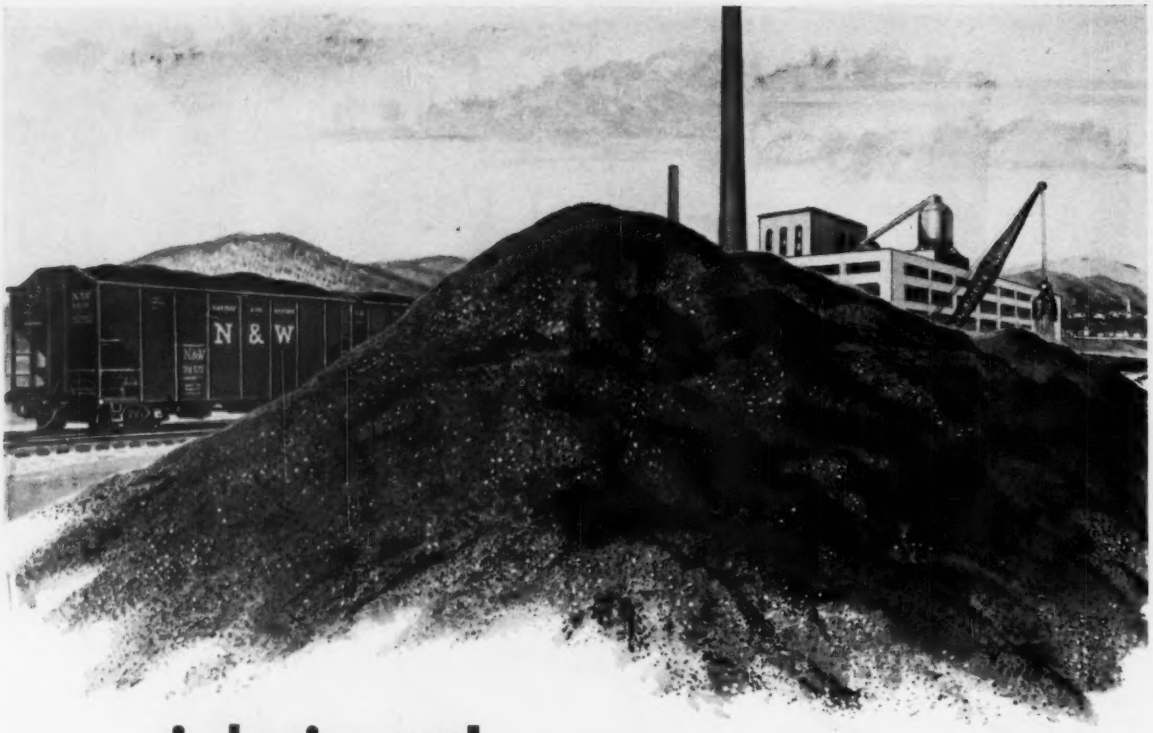

in buying coal

COST PER MILLION BTU IS NOT THE ONLY ANSWER

Cost per million Btu is important in buying coal . . . but it's only part of the story. Factors such as ash-fusion temperature, sulfur content, volatile content, free swelling index, sizing, production and preparation facilities at the tipple are most important. Various types of fuel-burning equipment demand special coal-burning characteristics.

Proper coal preparation means a desirable product. A typical washing and thermal drying operation, for example, changes raw coal with high ash and high total moisture to a finished product with low ash and low total moisture.

Fuel Satisfaction . . . the coals mined along the Norfolk and Western . . . are generally high in Btu content. In addition, they are mined and prepared by the most modern methods to produce coals that are high in "use values". Because there are many types of coal mined along the N&W, we can recommend one that exactly suits your equipment and your needs. For a careful analysis of your coal requirements, get in touch with one of the N&W bureaus listed here.

CONTACT YOUR N&W COAL BUREAUS

ROANOKE
N&W Coal Traffic Dept.
Telephone Diamond 4-1451
Ext. 3313, 423, 3249, 3732
Roanoke, Virginia

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Telephone Liberty 2-2229
Boston 10, Massachusetts

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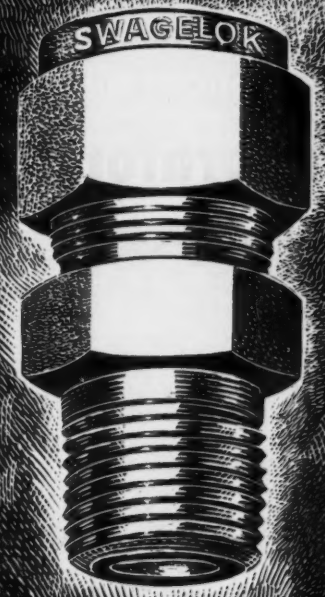
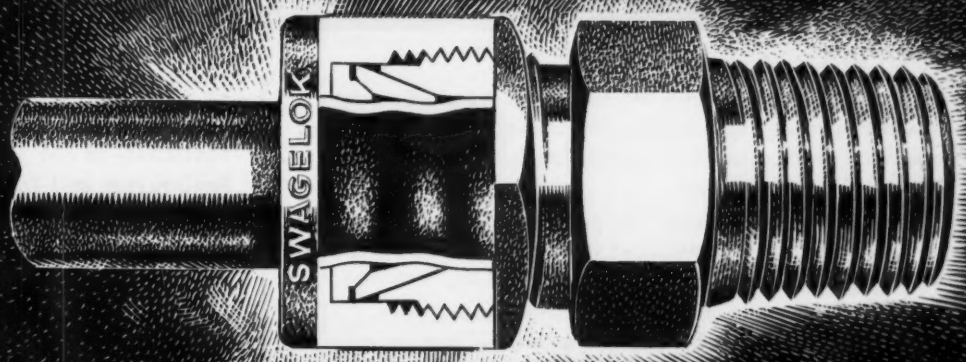
For more facts circle 838 on Reader Service card, p 227 circle 839 on Reader Service card, p 227 ➤



the Standard of Quality in Tube Fittings



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the name that stands apart from all others in the field . . . outstanding and unique in concept, craftsmanship and leakproof performance

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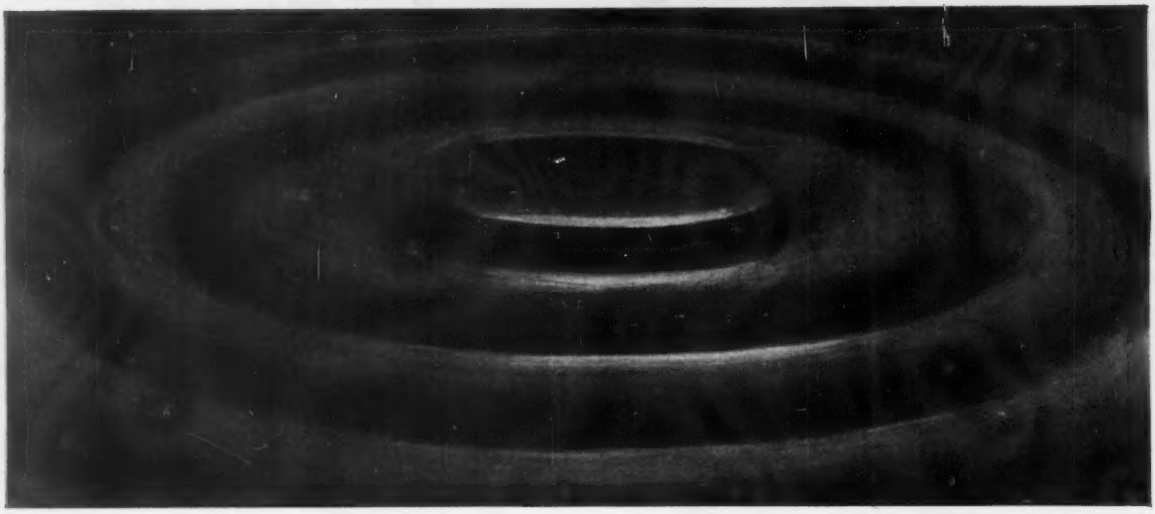
Griscom-Russell Evaporator Purities



Tests, recently conducted on a Griscom-Russell Bentube Evaporator in service at a large eastern utility, have shown that the G-R evaporator design consistently provides less than the guaranteed 1 ppm—as low as .005 ppm.

For full particulars on this test—the purities obtained, the importance of liquid levels and separators, and varying turbine loads, plus other useful information, contact your local G-R Representative.

This, and all the other information we have learned in our 90-plus years of engineering and manufacturing of heat exchange equipment, is yours, both as a service and as the basis for the design and construction of better evaporators, feedwater heaters, oil and air preheaters and coolers, and other heat transfer equipment for the power industry.

Specialists in the Engineering and Construction of Heat Exchange Equipment

feedwater heaters, evaporators, condensers, oil heaters, air, gas, and liquid heat exchangers—finned and bare tube, tank heaters, air-cooled fin-fan exchangers, sea water distilling plants, helically and longitudinally finned tubing, and many other products.

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A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION
GR 401

UNDERGROUND HOT PIPE PROTECTION

No Excessive Heat Loss	✓
Sure, Permanent Protection	✓
Protection From Corrosive Soil Conditions	✓
Low Installation Cost	✓
Minimum Maintenance Expense	✓

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TRI-SUL-ITE

3-WAY PROTECTION SYSTEM *

THE ZIEGLER GILSONITE MINERAL

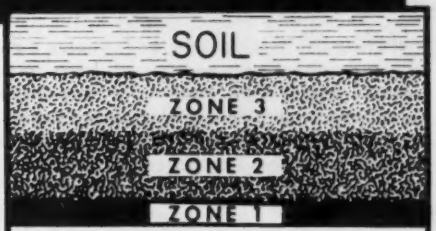
GIVES YOU ALL THESE ADVANTAGES

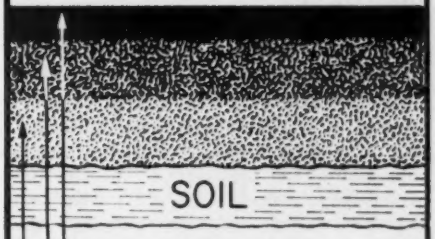
TRI-SUL-ITE is 100% mined Gilsonite... not a man-made product ... incompatible with water... unaffected by normal soil conditions. TRI-SUL-ITE is poured under and around all pipes in the trench. After proper curing, it forms three zones of protection against water, corrosion and heat loss.

Check the advantages of TRI-SUL-ITE and you'll see why more and more specifications call for this underground hot pipe protection. It's the only method that gives you safe... sure 3-way protection.

Before you specify protection for another underground piping system...

...write for complete literature on TRI-SUL-ITE





*** ZONE 1 PROTECTION: PERMANENT WATER BARRIER**

The first zone of TRI-SUL-ITE adjacent to the pipe, fuses from pipe heat into an impermeable, waterproof coating. It resists normal soil acids and alkalis. When it is plastic the pipe movement is contained within this zone. The first zone of TRI-SUL-ITE protection gives positive assurance that water cannot follow the grade of the pipe.

*** ZONE 2 PROTECTION: EXCELLENT INSULATOR**

The second zone consists of the edges of the TRI-SUL-ITE granules fused to isolate the air spaces, resulting in a highly effective insulator which minimizes heat losses to the soil.

*** ZONE 3 PROTECTION: INSULATOR AND WATER BARRIER**

The third zone of TRI-SUL-ITE granules is not fused by heat and provides maxium insulating efficiency plus good resistance to water penetration and protection against surface shocks and subsoil stresses.

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Agents in Principal Cities Throughout the United States and Canada.

MINES: "CASTLE PEAK," "LITTLE BONANZA," "LITTLE EMMA."

For more facts circle 841 on Reader Service card, p 227

Expansion Joint Design Moves out of the "Model T" Era

Badger first began fabricating packless metal bellows expansion joints more than 35 years ago. These "Model T" joints performed (and are still performing) with outstanding success in hundreds of process and steam line piping installations.

Starting in the 30's other expansion joint manufacturers entered the field. The most successful adopted many of the basic features of the original Badger design.

During the last decade, as industry's requirements became more stringent, and joint manufacturers gained fabricating and field experience, certain fundamental problems inherent in the early designs became evident. Most of these problems were solved through a series of modifications. (Among which was the Badger Directed Flexing Self-Equalizing Joint — the famous "DFSE" Design.) But, at best, the modifications were stop-gap measures which complicated the joints and greatly increased their weight. A fundamental reassessment of expansion joint engineering data was needed. Badger led the way: In 1956, a task force completed a three-year research program and the first S-R (Service-Rated) Expansion Joints were produced.

In the three years they have been available, S-R Expansion Joints have been both an engineering and a sales success. But like many revolutionary concepts which upset tradition, the full implication of the advantages S-R Joints offer is still not universally understood. The message that follows is an attempt "to set the record straight."

• • • • •

Equalization — fact and fiction

Many users of expansion joints are under the impression that the so-called "equalizing" rings on today's conventional type expansion joints distribute movement equally among all the corrugations of the bellows. It is argued that as the joint absorbs thermal movement, the tops of the rings progressively come into contact until the bellows is fully compressed thus limiting the amount of compression which any one corrugation can ultimately absorb (see diagram 1). In *this* sense the rings do contribute to the "equalization" of movement by physically limiting the compression of each corrugation to the distance between any two adjacent rings.

Diagram 1

Conventional Type Expansion Joint. Cross-sections of rings and bellows of a conventional "self-equalizing" joint showing cold and hot positions. Note that true equalization of movement can only be obtained when tops of all rings are in contact — an impractical and dangerous situation.

Note, however, that the degree of compression will not be truly equalized until the tops of all the rings are in contact. But, when such a condition occurs, serious problems will result. If the limit of compressibility is reached before the thermal expansion has been completely absorbed, exceedingly large forces will be transmitted through the pipe line to the anchors and connected equipment. On the other hand, if the joint is compressed only partially, not all of the corrugations will absorb movement to the same degree.

How S-R Joints solve equalization problem

Badger S-R Expansion Joints feature the new Curvilinear Corrugations which naturally assume an "all curve" shape under pressure (diagram 2), assuring more equal distribution of stresses throughout the bellows material. Furthermore, the shape, height and pitch of the corrugations are based on a carefully engineered correlation. Thus, reasonably equal distribution of movement among the corrugations is obtained, even in joints not equipped with reinforcing rings.

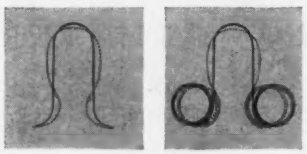

Diagram 2

Badger S-R Expansion Joint. Cross-sections of S-R Joints (Series 50 left, Series 150 right). The movement of the corrugations is shown by dotted and solid lines. Compare configuration and effective height of corrugations, position and size of rings with conventional joint.

Equalization of movement is inherent in the design and functioning of the bellows on Badger S-R Joints. On the basis of provable engineering criteria, the prime purpose of reinforcing rings of any design is to retain the hoop dimension (diameter) of the corrugations when they are subject to internal pressure. This Badger's simple, lightweight tubular reinforcing rings do. But, in addition, the new tubular shape of the rings does contribute to joint flexibility and life by permitting flexing over a more effective portion of the total corrugation height than conventional cast or fabricated equalizing rings.

Better performance, lower cost

Briefly, then, Badger S-R Joints alone offer these advantages: Better equalization of movement which results in elimination of localized stresses and leads to longer joint life; a simple, lightweight design that makes installation easier, eliminates cumbersome castings and fragile mechanical devices; complete range of sizes from 3″ to 72″ made from any workable metal and with a wide choice of accessories.

Badger S-R Joints are probably the answer to your problem. There's an easy and quick way to find out — ask the Badgerman for his recommendations. Write or phone today. Badger Manufacturing Co., 230 Bent St., Cambridge, Mass.

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BADGER S·R EXPANSION JOINTS

For more facts circle 842 on Reader Service card, p 227

circle 843 on Reader Service card, p 227 ➤

a modern suit of armor . . . *

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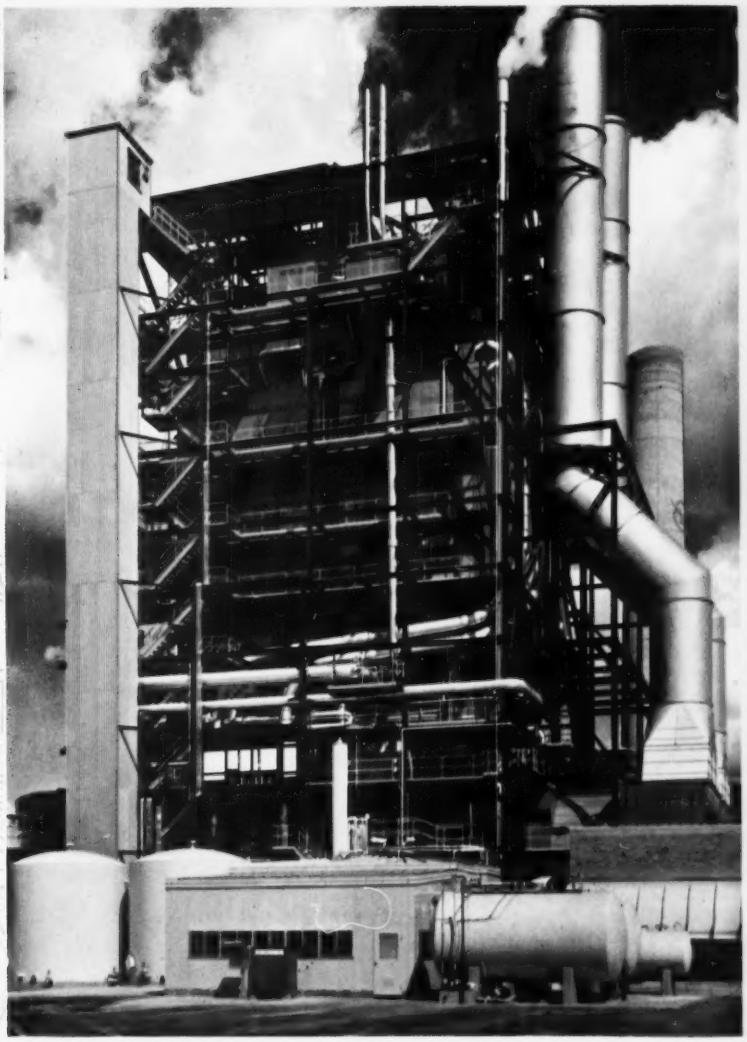
* *Louisiana Power & Light Company used it* . . . at New Orleans and Sterlington, La. for colorful, durable protection of their new boilers. Avoncraft porcelain enamel provided weather-proof covering to insulated surfaces on the roof and sides and was worked into the curvatures of the air ducts, pre-heaters and stack uptakes. The result? A very thorough job of protection with a modern building material as attractive as it is practical. All steel for lagging was engineered, fabricated, porcelainized and erected by Avoncraft, eliminating fitting at the job site. We will install porcelain enamel lagging on boilers anywhere, in any color desired.

There is no compromise for quality . . . specify Avoncraft.

Write for our full-color brochure, "Function and Lasting Beauty".



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POWELL has high pressure

high temperature valves in stock for quick delivery

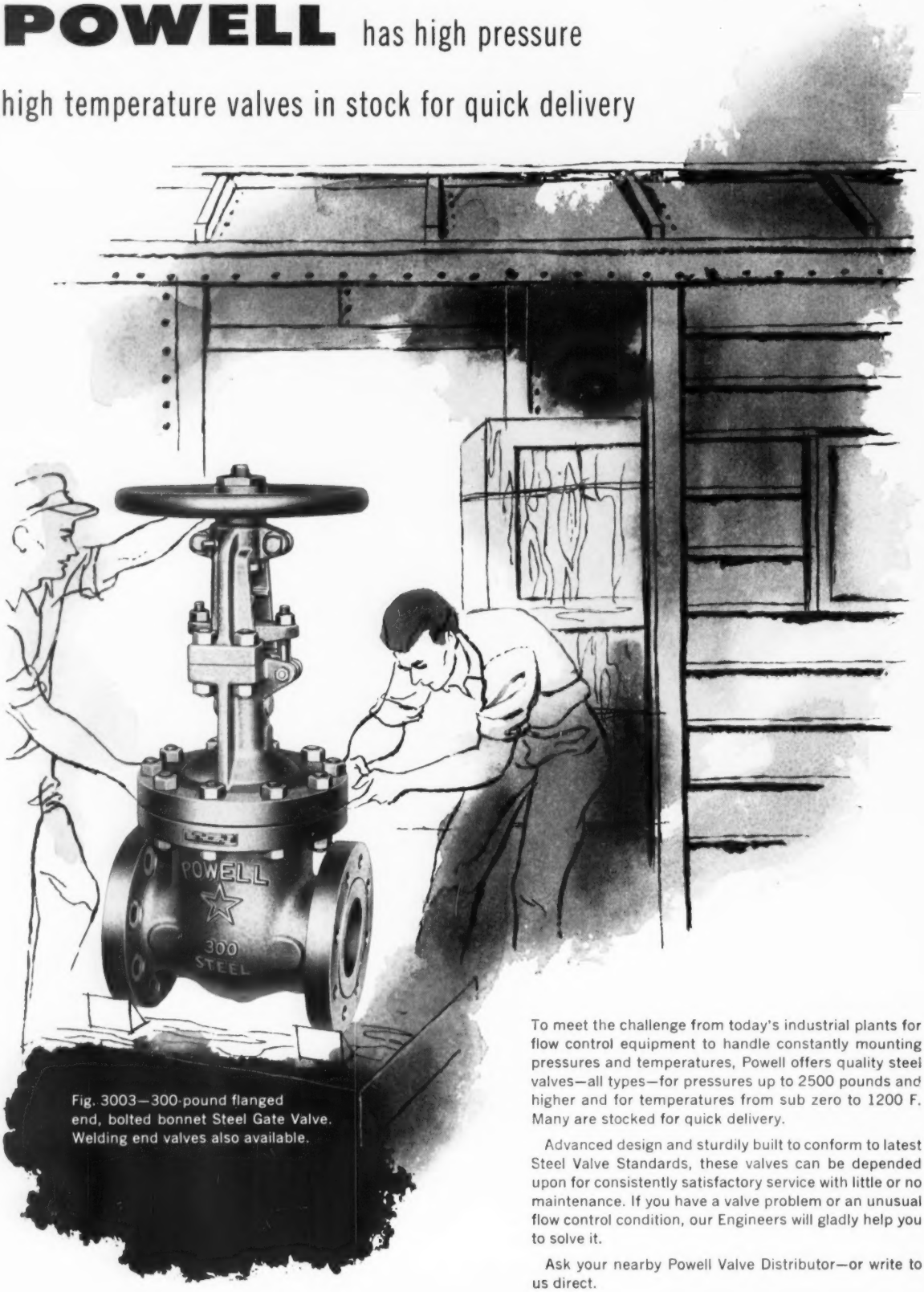

Fig. 3003—300-pound flanged end, bolted bonnet Steel Gate Valve. Welding end valves also available.

To meet the challenge from today's industrial plants for flow control equipment to handle constantly mounting pressures and temperatures, Powell offers quality steel valves—all types—for pressures up to 2500 pounds and higher and for temperatures from sub zero to 1200 F. Many are stocked for quick delivery.

Advanced design and sturdily built to conform to latest Steel Valve Standards, these valves can be depended upon for consistently satisfactory service with little or no maintenance. If you have a valve problem or an unusual flow control condition, our Engineers will gladly help you to solve it.

Ask your nearby Powell Valve Distributor—or write to us direct.

THE WM. POWELL COMPANY DEPENDABLE VALVES SINCE 1846 CINCINNATI 22, OHIO **world's largest family of valves**

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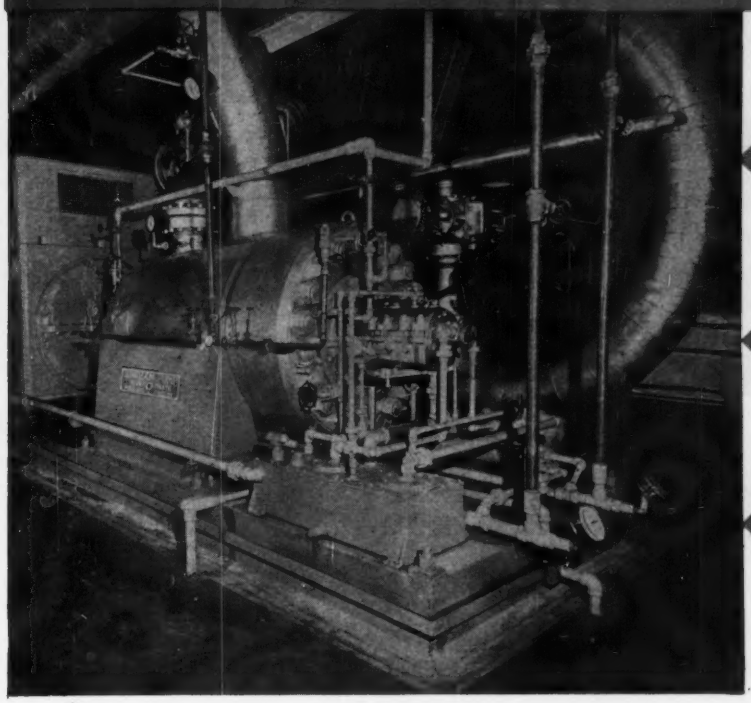
Bingham

"DOUBLE VOLUTE" BARREL TYPE BOILER FEED PUMPS

THE ULTIMATE IN DEPENDABILITY FOR HIGH PRESSURE SERVICE



BINGHAM BARREL TYPE HIGH PRESSURE BOILER FEED PUMPS

PACIFIC POWER AND LIGHT COMPANY
Glenrock, Wyoming

ENGINEERS AND BUILDERS
Ebasco Services, Inc.

Bingham Barrel Type Boiler Feed Pumps, installed in the Pacific Power & Light Company plant at Glenrock, Wyoming. Each pump is designed to deliver 1875 GPM at 2300 PSI, operating at 3560 RPM.

Bingham "Double Volute" Barrel Type Boiler Feed Pumps are furnished with forged outer barrel for high pressure service. Pumps of this type are available for a wide range of capacities and heads. Your nearest *Bingham* office will be glad to give you full details on request.

BINGHAM BARREL TYPE BOILER FEED PUMPS feature:

- "Double Volute" construction.
- Double suction first stage for low NPSH.
- Balanced axial thrust (no balancing drums needed).
- Kingsbury Thrust Bearings.
- Stuffingboxes are arranged for either packing or mechanical seals.
- Stuffingboxes are subjected to suction pressure only.
- Designed for high operating speeds.

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KEYSTONE STEAM GENERATORS

● Consulting Engineers and their staffs are actively engaged in selecting and coordinating the most dependable equipment available. We are proud of the confidence they have placed in Erie City.

Built-in quality is the backbone of confidence — and hundreds of Keystone Steam Generators are in service today because they incorporate proven quality design features.

Design features such as tangent furnace and outer wall tubes plus double steel encased insulation keep outer casing cool to the touch. The top smoke outlet eliminates the inconvenience of a hot stack in the aisle, minimizes required floor space and reduces building costs. Keystones have no baffles or headers which generally are a source of troublesome maintenance.

These features and many more have proved the Keystone to be a safe, highly efficient steam generator with plenty of reserve power. Write for our comprehensive Bulletin SB-5991-K.

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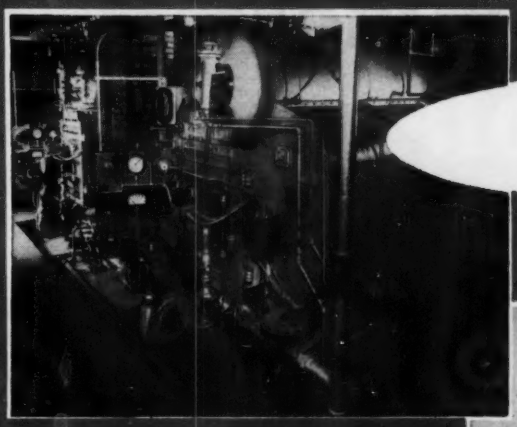
WASTE HEAT BOILERS • FIRE and WATER TUBE PACKAGE BOILERS
OIL and GAS BURNERS • STOKERS • PULVERIZERS

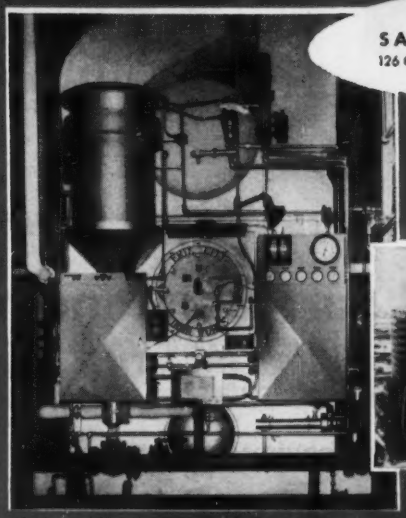


ELWOOD S. TOWER
CONSULTING ENGINEER
311 INVESTMENT BUILDING
PITTSBURGH 22, PA.

Rochester General Hospital
Rochester, Pennsylvania
2—150 h.p. Keystone Steam
Generators, Oil and Gas Fired

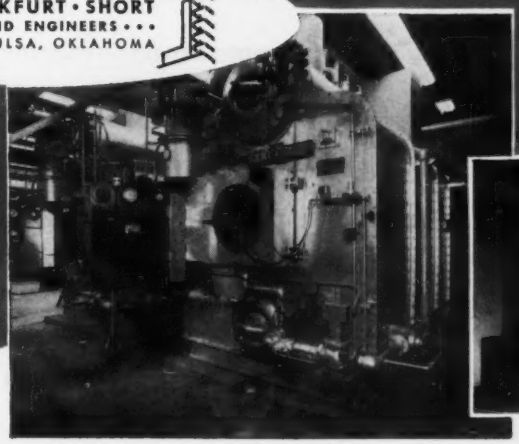
Architect—Arthur L. Marshall & Associates
Rochester, Pennsylvania

SANFORD AND DUDLEY
126 Carondelet Street • New Orleans, Louisiana
CONSULTING ENGINEERS

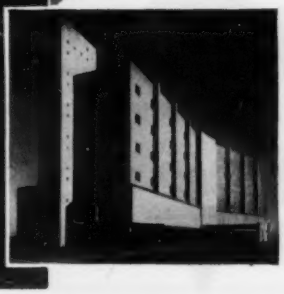


Charity Hospital
New Orleans, Louisiana
1—800 h.p. Keystone Steam
Generator, Oil and Gas Fired

COSTON • FRANKFURT • SHORT
• • • ARCHITECTS AND ENGINEERS • • •
OKLAHOMA CITY, TULSA, OKLAHOMA



Baptist Memorial Hospital
Oklahoma City, Oklahoma
2—[illegible]0 h.p. Keystone Steam
Generators, Gas Fired



For more facts circle 846 on Reader Service card, p 227

In Economizers

Here are 7 advantages of the new Green Cast Iron Extended Surface Economizer:

★ For replacement of present steel tubes or on new boiler installations.

1. Lasts longer.
2. Requires less space.
3. Has lower draft loss.
4. Is more corrosion-resistant.
5. Is more erosion-resistant.
6. Withstands lower feed-water temperature.
7. Costs less.

Green

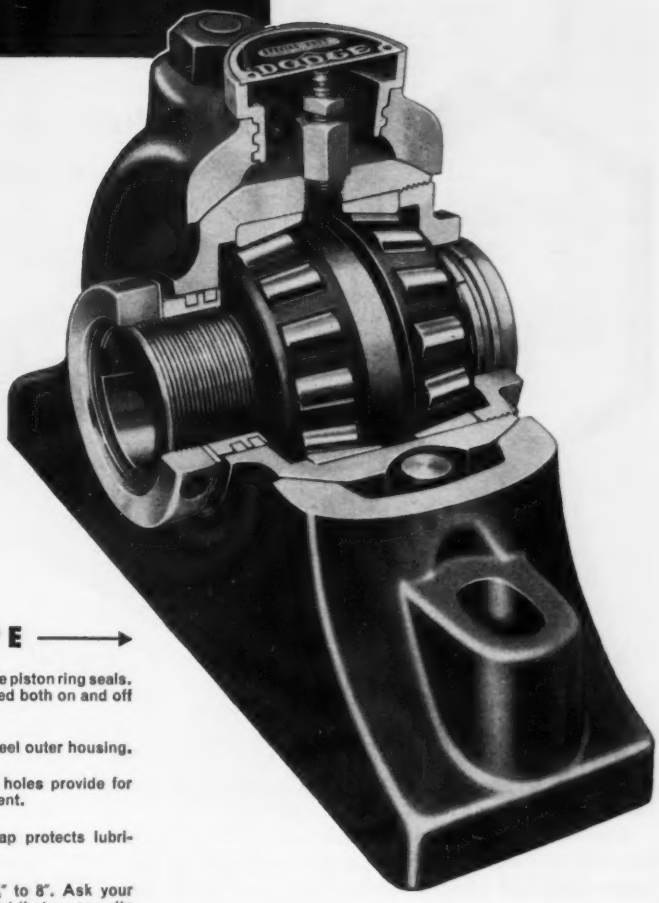
SAVE MONEY WITH GREEN CAST IRON FUEL ECONOMIZERS

THE GREEN FUEL ECONOMIZER CO., INC. BEACON 3, NEW YORK

DODGE PILLOW BLOCKS

WITH TIMKEN BEARINGS

America's super-quality line—with a 35 year record of keeping performance *up* and costs *down!* Five types—to fit practically any service condition. All assembled, adjusted, lubricated and *sealed* at the factory for precision performance—long life—dependability.



SPECIAL DUTY TYPE →

- Designed for extreme precision and high load capacities.
- Fully self-aligning.
- Special Duplex Timken Roller Bearing with tapered bore.
- Split tapered sleeve with straight cylindrical bore extends through entire length of housing.
- Easy to mount or demount. Adapter nut (or collar) clamps adapter sleeve to shaft with extreme firmness.
- Automotive type piston ring seals. Bearing is sealed both on and off the shaft.
- Rugged semisteel outer housing.
- Elongated bolt holes provide for lateral adjustment.
- Special dust cap protects lubrication fitting.
- Shaft sizes 1¾" to 8". Ask your local Dodge Distributor—or write us for Bulletin A670 giving complete technical data on America's most complete line of mounted bearings.

DODGE MANUFACTURING CORPORATION, 3200 Union St., Mishawaka, Ind.

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look in the *white* pages of your telephone directory for "Dodge Transmissioneer."

DODGE
of Mishawaka, Ind.

For more facts circle 848 on Reader Service card, p 227

HOW WESTERN PRECIPITATION'S UNIQUE "KNOW-HOW" BENEFITS YOU!

The science of dust, fume and fly ash recovery is a highly technical one. Moreover, the fact that there are a number of basic methods for separating suspensions from industrial gas streams – each with certain advantages and disadvantages – further complicates the basic problem.

Even two different plants cleaning the same type of gas may find that such variables as capital investment policies, maintenance and labor schedules, and other similar management functions may make one type of equipment the logical choice for one plant – a basically different type of equipment the best solution for the other.

That's why Western Precipitation's position in the gas cleaning field is so unique. It is the *only* organization that designs, engineers and installs *all* the basic types of gas-cleaning equipment. It is completely unbiased in its viewpoint, and is able to show you exactly how the overall costs, the collection efficiencies and the operating requirements will vary for each installation – with each type of collecting equipment that may be applicable.

Such an unbiased evaluation is invaluable in assuring optimum returns from your gas-cleaning dollar. Best of all, this unique "know-how" costs you nothing. It is a basic part of Western Precipitation's service to industry throughout the United States, Canada and the Free World.

Our nearest representative will gladly place this unique fund of experience at your service. Why not call him today?

Only WP has all 6

1. COTTRELL Electrical Precipitators
2. MULTICLONE Mechanical Collectors
3. CMP Combination Units
4. DUALAIRE Jet-Cleaned Filters
5. THERM-O-FLEX Hi-Temp Filters
6. TURBULAIRE-DOYLE Scrubbers

Also: HOLO-FLITE Processors
HI-TURBIANT Heaters

G-130

WESTERN
PRECIPITATION
CORPORATION

Engineers and Constructors of Equipment for Collection of Suspended Material from Gases . . . and Equipment for the Process Industries

LOS ANGELES 54 • NEW YORK 17 • CHICAGO 2 • PITTSBURGH 22 • ATLANTA 5 • SAN FRANCISCO 4

Representatives in all principal cities

Precipitation Company of Canada Ltd., 8285 Mountain Sights Avenue, Montreal 9

For more facts circle 880 on Reader Service card, p 227

DOW | SARAN LINED PIPE

"Hungry" water starves in Saran Lined Pipe

Steam turbines require water so pure that processors call it "hungry" — it absorbs impurities from any iron pipe that carries it. These metal contaminants in turn clog the turbine blades, can increase fuel cost as much as 12%. But Saran Lined Pipe travels the "hungriest" water from source to turbine without adding impurities, without corrosive pipe wear. For an example . . .

Gulf States Utilities Company's year-old Roy S. Nelson Power Station at Westlake, Louisiana, designed and constructed by Stone & Webster Engineering Corporation, produces over 200,000 kilowatts for residential, commercial, industrial and agricultural uses. This plant uses 2800 feet of Saran Lined Pipe to move acid and caustic treated well water for purification prior to steam conversion. Its battery of softeners and demineralizers produces 400 gallons of chemically pure water per minute.

Projected studies indicate, in spite of the action of caustic, sulphuric acid and the 120°F. water temperatures, the use of Saran Lined Pipe will reduce pipe replacement by 50%, while protecting the turbines from impurities.

Whenever dependable piping systems are required, whatever the degree of corrosion or chemical activity, consider Saran Lined Pipe. Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200°F. They're easily cut, fitted and modified in the field without special equipment. For more information, write Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan, Dept. 2502DW10.

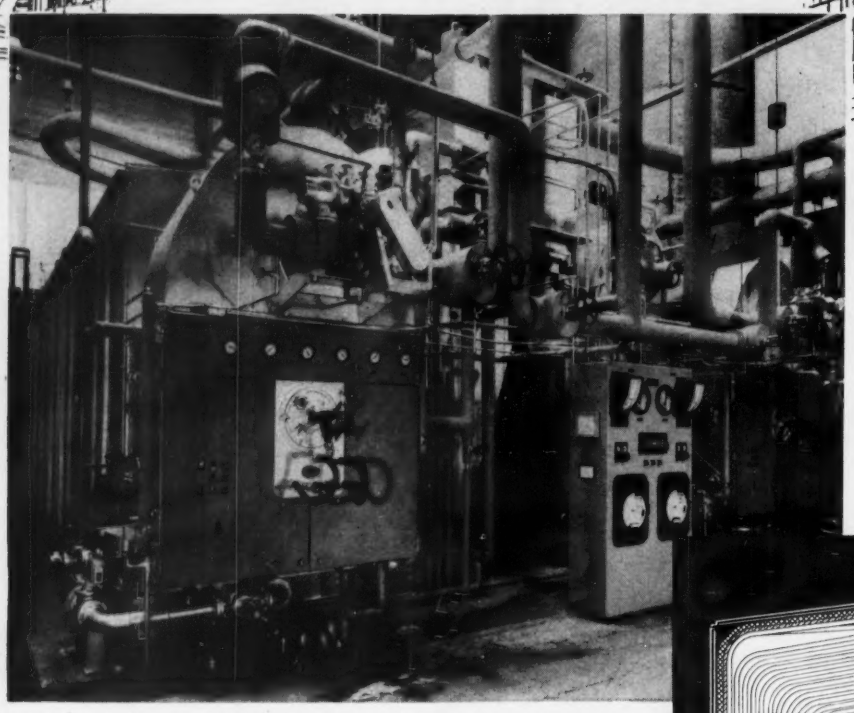
THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

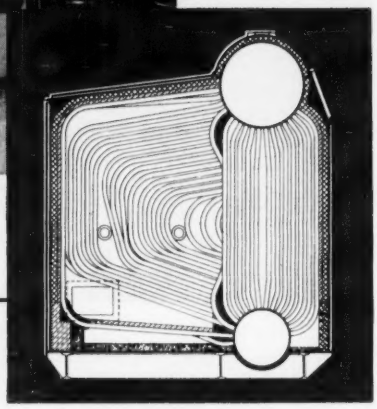
P·G and E·
Pacific Gas and Electric Company

KEELER dk package steam generators

...playing an important role in

SAN FRANCISCO'S CHANGING SKYLINE





PACIFIC GAS & ELECTRIC COMPANY'S "STATION T," San Francisco
one of two central heating plants operated by this progressive utility

Expansion and modernization engineered by PG&E staff

Design of plant addition and installation by BUMSTEAD-WOOLFORD CO., San Francisco

Several new, multi-story buildings are reshaping San Francisco's skyline. Their steam requirements are supplied by Pacific Gas & Electric Company's Station T, recently modernized for added steam generating capacity with the installation of two Keeler Type D K Package Steam Generators.

PG&E is aptly described as a true partner in California's growth—in fact, by most standards, it is the largest utility of its kind in the nation! In expanding its central steam plant operations, Keeler D K's were selected to enable the firm to keep pace with the increasing demands of its clients in the "new downtown area" served by Station T.

Each of the new D K's is a 55,000-lb. stm/hr capacity unit designed for 200 psi safe working pressure and combination oil-gas firing. They are providing PG&E with a nearly doubled gross steam output in essentially the same floor space as the old boilers which they replaced.

Flexibility, however, is the big advantage—a natural for a central steam plant with unpredictable and varying loads. The Keeler D K's are efficiently handling large load swings —quickly and with a stable water level.

Multi-purpose Keeler D K's are made in 24 sizes for gas, oil or combination firing in capacities up to 80,000 lb/hr. Write for full data . . . see for yourself why this popular D-type steam generator has earned a nation-wide reputation!

The Seal of Quality in Water Tube Steam Generators

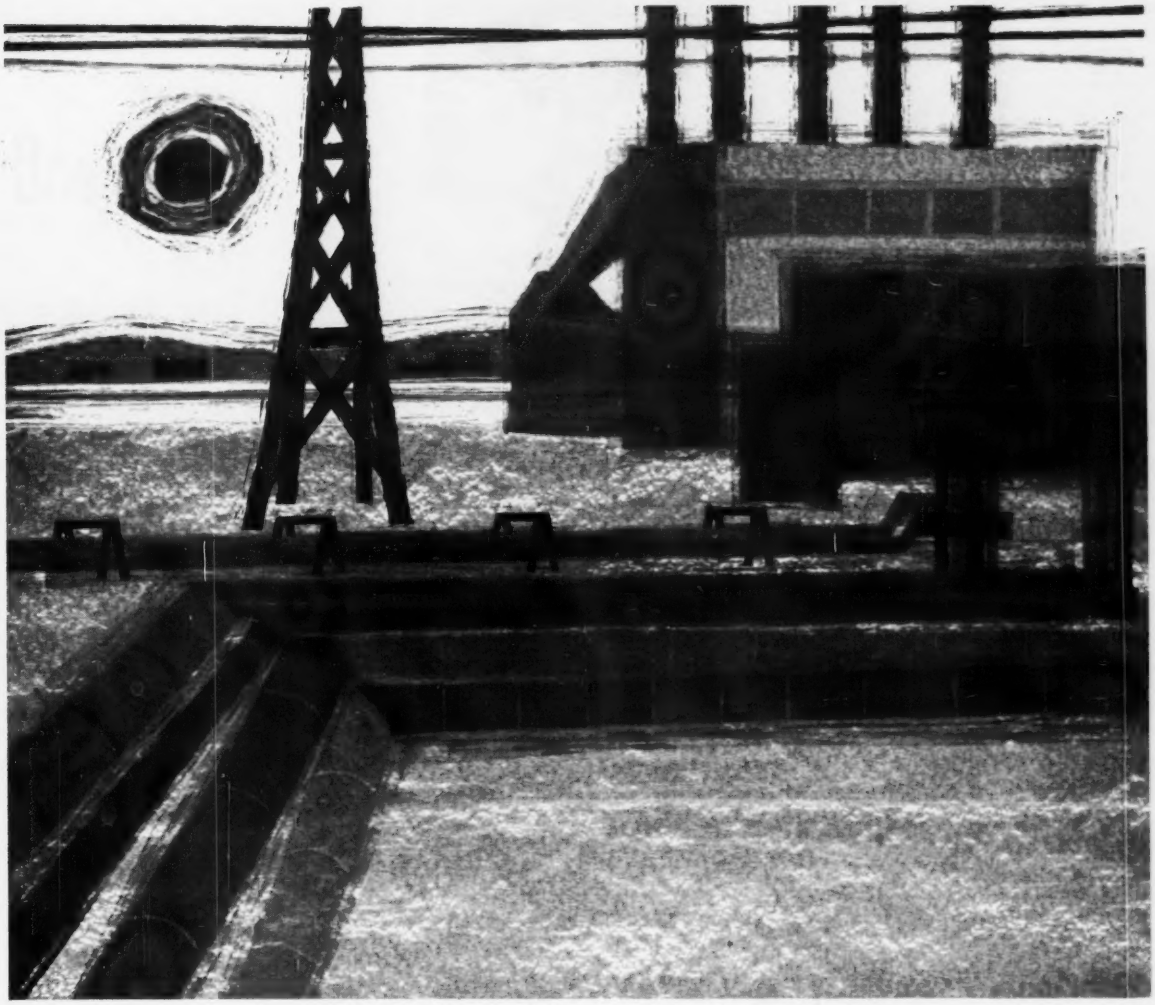
— ESTABLISHED 1864 —

Write For Bulletins

No. DK-2: Type DK Package Boilers
No. F-14: Type CP Boilers
No. M-2A: Type CPM Package Boilers
No. MK-1: Type MK Boilers

KEELER WATER TUBE Boilers

E. KEELER COMPANY
200-300 West St., Williamsport, Penna.
— OFFICES IN PRINCIPAL CITIES —
In Canada: Canadian Vickers, Ltd., Montreal, P. Q.



HOW CAN ALUMINUM JACKETING SERVE YOU BETTER AT LESS COST?

You'll find the answer to this, and many other questions concerning aluminum jacketing, in Kaiser Aluminum's free 40-page brochure, "Insulation Jacketing Materials and Methods."

How does the installed cost of aluminum jacketing compare with other insulation finishes? How can dry-wall construction techniques save you labor time and money? What are "snap jackets" and how can they cut installation costs? How do aluminum's advantages of superior corrosion resistance and durability work in your favor, saving you hundreds of dollars over the years?

The answers to these questions can save you money on installed costs and maintenance costs. They're all here—plus full information on aluminum jacketing alloys, fasteners, applications, specifications.

Send for Kaiser Aluminum's "Insulation Jacketing Materials and Methods" brochure now. Mail the coupon!

Kaiser Aluminum construction industry specialists are available to offer immediate engineering assistance on the use of aluminum for insulation jacketing, boiler lagging or other applications in your industry. Contact your nearest Kaiser Aluminum sales office for full information.

KAISER ALUMINUM

Kaiser Aluminum & Chemical Sales, Inc.
Dept. IB-6, 1924 Broadway
Oakland 12, California

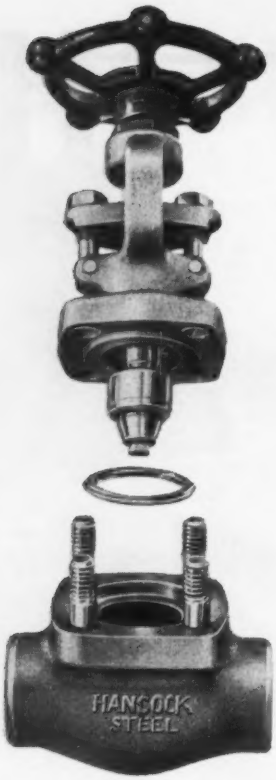
Please send me your free brochure, "Insulation Jacketing Materials and Methods."

NAME_____

ADDRESS_____

CITY_____ **STATE**_____

For more facts circle 851 on Reader Service card, p 227

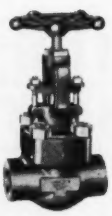


NEW VALVE-OLOGY

shuts off costly maintenance

Hancock 600# Steel Valves incorporate new concepts in valve-ology that reduce valve maintenance and equipment down-time. The forged steel bonnet and body have butting flanges so strong no distortion is possible. The flanges form a bonnet joint that utilizes the sealing power of a Flexitallic* gasket so effectively not even pressures exceeding ten times the rating of the valve can cause a blowout.

Hancock valve-ology makes full use of stainless steel to reduce your valving cost. Seat, disc, stem, swing bolts and nuts, thread bushing, packing gland follower—all are stainless steel. Globe, Angle, "Flocontrol", Lift Check, and Hi-Pressure Drop designs available. A high degree of standardization simplifies servicing and inventory needs. Your industrial supply distributor will gladly give you full details on Hancock Valve quality and performance. Phone him today.



Hancock 600# Steel Globe Valve. Type 5500 Line. Sizes: ¼" thru 2".

*Trademark of Flexitallic Gasket Company

MANNING MAXWELL & MOORE M&M TRADE MARK

HANCOCK STEEL VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

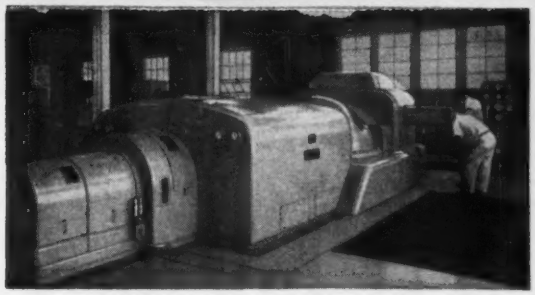
Consolidated Ashcroft Hancock Division • Watertown, Massachusetts
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

For more facts circle 852 on Reader Service card, p 227

circle 853 on Reader Service card, p 227 ➤

One reason why Fairfield, Illinois has efficient electric service—

Nonpareil Turbine Oil



Plant superintendent James Easton and Standard Oil industrial lubrication specialist Charlie Brown inspect 5,000 kw. Worthington turbine, one of four turbines in Fairfield Municipal Light & Power Company plant lubricated with NONPAREIL Turbine Oil.

These turbine installations trace the record of growth in electric power consumption in Fairfield, Illinois, over the past 19 years:

Type	Turbine Cap.	Installed
Westinghouse	1,500 kw.	March, 1940
Westinghouse	2,500 kw.	March, 1942
Westinghouse	4,000 kw.	March, 1949
Worthington	5,000 kw.	July, 1957

When the first turbine went into service, Fairfield Power plant management decided upon a turbine lubricant they felt would be dependable—NONPAREIL Turbine Oil. Standard Oil, they found, would give them concrete evidence of the oil's dependability. They received a certificate guaranteeing that, for the life of the turbine, the acidity of the oil would never exceed 0.15 mg. KOH/g. Indeed, through the years the oil has remained at a much lower acidity level, usually in the order of 0.06 mg. KOH/g. Periodic analysis of the oil in Standard's Whiting laboratory confirms that the oil is performing according to guarantee.

The kind of service Fairfield Municipal Light & Power gets from NONPAREIL Turbine Oil comes about this way: NONPAREIL is the subject of special refining techniques and handling. A special crude is used as a base stock. All sludge-forming compounds are removed. An oxidation inhibitor which permanently controls acidity is added. No sweetening or resting of NONPAREIL Turbine Oil is required at any time.

Men with experience in turbine lubrication can give you more facts about NONPAREIL Turbine Oil. Call your nearby Standard Oil office in any of the 15 Midwest and Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

You expect more from **STANDARD** *and you get it!*

Standard's Charlie Brown, here with Easton, supervised installation of NONPAREIL Turbine Oil in Worthington turbine. His experience and training qualify him for such work. Charlie received science training and graduated from Eastern Illinois State College. He has nine years' service with Standard Oil and has completed Standard's Sales Engineering School.

bends like this are easy with...

Republic ELECTRUNITE Boiler Tubing

because uniform ductility is built-in

Uniform ductility of ELECTRUNITE® made a big difference at the power plant installation of Toms River-Cincinnati Chemical Corporation, Toms River, New Jersey.

This C-E Boiler, Type VU-50, engineered and erected by Combustion Engineering, Inc., New York City, was designed for maximum operation of 157,000 lbs. per hour at 650°F., with 600 lbs. psi design pressure. Fifty-one tons of Republic ELECTRUNITE Boiler Tubing were used in this unit.

Here, Republic ELECTRUNITE Boiler Tubing met the curvature of the boiler design in a severe test of uniform ductility. Bends were smooth and uniform, fitted easily into the boiler head drum holes. Results: Savings in installation time and costs.

ELECTRUNITE is made of highest quality flat-rolled open-hearth steel produced in Republic's own mills, carefully controlled every step of the way. Full normalizing, uniform wall thickness and diameter, and uniform ductility assure easy workability and in service dependability.

ELECTRUNITE is produced by the exclusive process that ELECTRically-UNITEs the tube under pressure without additional foreign or extra metal. This process is universally accepted by leading technical authorities, code societies, boiler and heat exchanger manufacturers, Federal and State committees.

To learn more about ELECTRUNITE for boiler, heat exchanger, condenser, or evaporator applications, call your Republic representative. Or, write direct.

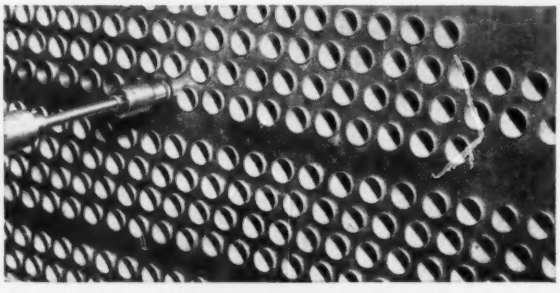
FARROWTEST®—QUALITY YOU CAN MEASURE. Not a laboratory theory, not a mere inspection tool, but an exclusive production test that detects and rejects tubing containing defects of critical size. FARROWTEST is offered as an alternative to other less positive tests in accordance with table below, at no extra cost.

QUALITY YOU CAN SEE! Republic ELECTRUNITE Boiler Tubing uniform ductility pays off in fit-right installations. Full normalizing and true concentricity assure easier roller expanding. Trouble-free service on the inside is a big factor in savings in installation time and costs.

FARROWTEST REJECT TABLE

Wall Thickness (B.W. Gage)	Minor dimension of the defect (Length or Depth)	Defective Area (Length, Depth Plane)
20	.006"	.0025 sq. inches
18	.006"	.003 sq. inches
16	12½% of wall	.003 sq. inches
14 and 13	12½% of wall	.004 sq. inches
12 and heavier	12½% of wall	.005 sq. inches

FARROWTEST detects and rejects not only tubing containing defects which completely penetrate the wall; but also tubing with defects equal to, or greater than, those shown in this table. For irregular defect shapes, a tube with defect area equal to or greater than shown above is rejectable. Where required, sensitivity of FARROWTEST equipment can be calibrated to reject defects of lesser specified area than shown in table, at extra cost.



GOT A WATER PROBLEM? Republic ELECTRUNITE Stainless Steel Heat Exchanger Tubing resists corrosion and provides long trouble-free service for main surface condensers in utility power plants where water is used directly from natural sources. Call your Republic representative, or write direct.

REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
DEPT. C-7782-A
221 EAST 131st STREET • CLEVELAND 8, OHIO

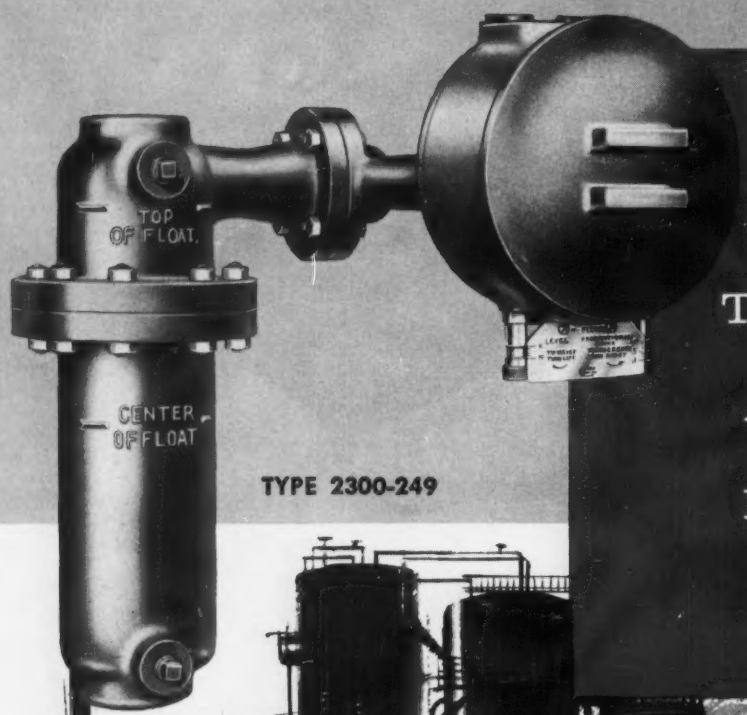
Please send additional information on the following products:

☐ Republic ELECTRUNITE Boiler Tubes
☐ Republic ELECTRUNITE Heat Exchanger Tubes
☐ Carbon, or ☐ Stainless ☐ FARROWTEST Brochure

Name_____ Title_____
Firm_____
Address_____
City_____ Zone_____ State_____

For more facts circle 854 on Reader Service card, p 227

Choose Electronic or But Choose the



TYPE 2300-249

THE CONTROLLERS THAT HANDLE ALL YOUR LIQUID LEVEL PROBLEMS

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD... CHANCES ARE IT'S CONTROLLED BY...

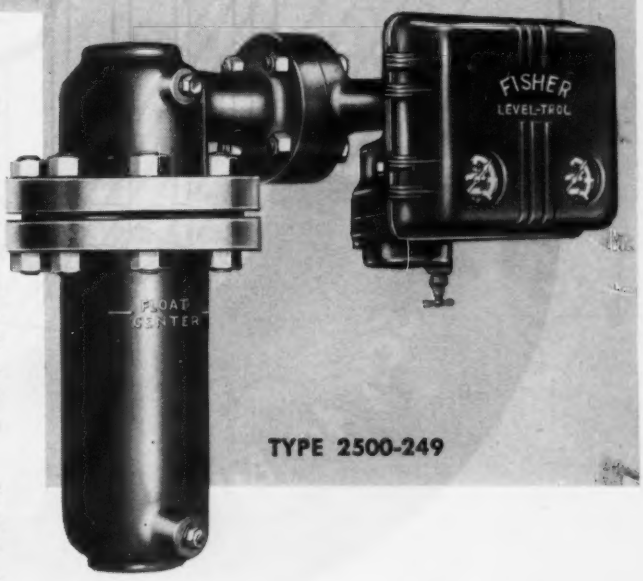
Choose Pneumatic

FISHER LEVEL-TROL®

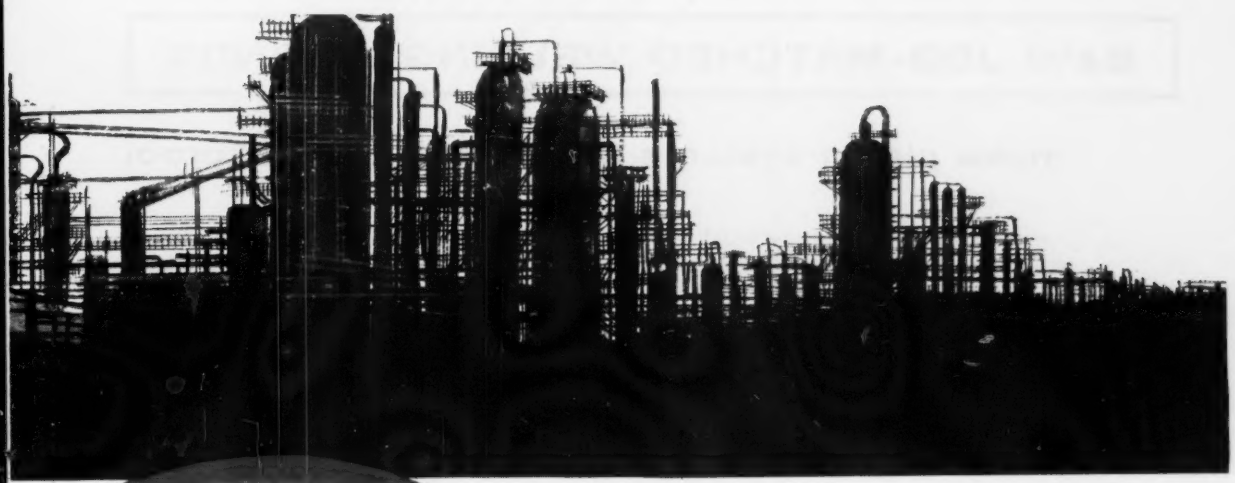
Using essentially the same displacement float assembly and other components that have made the Level-Trol so popular in the process industries, Fisher can now provide the Level-Trol with either a pneumatic or an electronic pilot. The same style of Level-Trol mounting and displacement floats in sizes up to 120″ can be supplied for either pilot.

Type 2300-249 Electronic Level-Trol: Explosion-proof design and external adjustments for proportional band and liquid level set point make the Fisher Electronic Level-Trol ideal for use in hazardous locations. Delivers a proportional 1 to 5 milliampere dc signal through 3000 ohm load. Has plug-in converter with printed circuit.

Type 2500-249 Level-Trol: Highly flexible! Can be pneumatically operated with a wide variety of pilots. Handles practically any liquid level, interface level or specific gravity control or indication problem.



TYPE 2500-249



FISHER® Controls
SINCE 1880

FISHER GOVERNOR COMPANY
Marshalltown, Iowa / Woodstock, Ontario / London, England
BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIPMENT CO., CORAOPOLIS, PENNSYLVANIA

For more facts circle 855 on Reader Service card, p 227

B&W JOB-MATCHED WELDING FITTINGS

make piping systems permanent and leakproof

. . . you get positive fit-up to pipe which means welding is easier, faster and more sure

. . . you get dimensional accuracy which means that, with a sound weld, piping is maintenance-free for the life of the system

. . . you get extra long life because you can choose the correct steel for your application

Specify B&W Welding Fittings and Flanges on your next piping job. They're available in a complete range of types and sizes in carbon steel and, of course, the famous B&W CROLOYS. Call your local B&W District Sales Office or any qualified welding fittings distributor. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

TA 9025-WF3

B&W

THE BABCOCK & WILCOX COMPANY

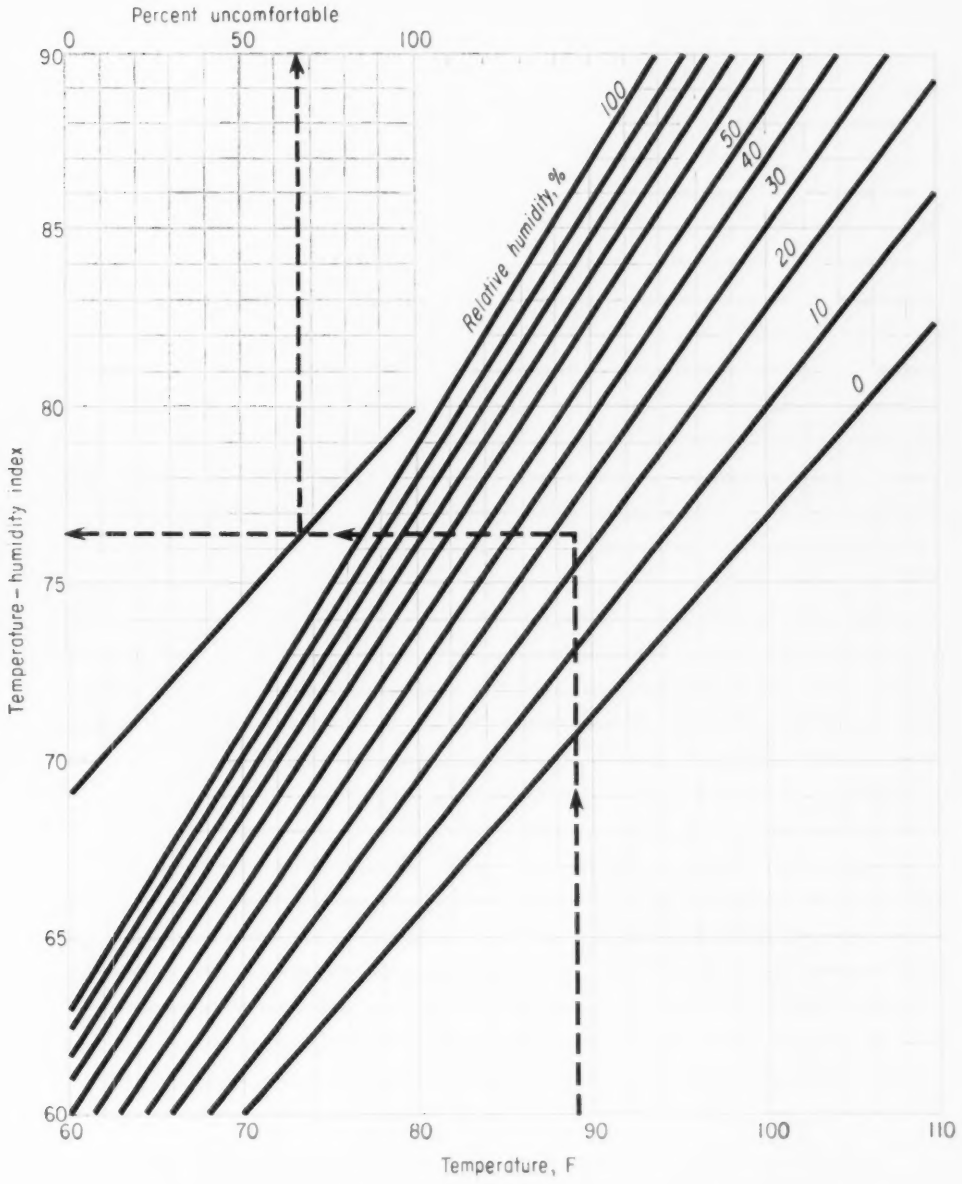
TUBULAR PRODUCTS DIVISION

Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

For more facts circle 856 on Reader Service card, p 227

Power's data sheet

No. 326



Temperature-humidity index measures worker comfort

New index will help building managers and plant engineers determine when they should turn on air conditioning (at 60 or above), when they should apply added air-cooling devices (at 75 or above). Index also helps utilities in estimating loads. If plant data is in the form of temperatures, index may be calculated from basic Weather Bureau formula. Multiply sum of wet-bulb and dry-bulb temperatures by 0.4. Add product to 15. This total equals index.

J F Hyam, *Riverside, Ontario, Canada*

© POWER

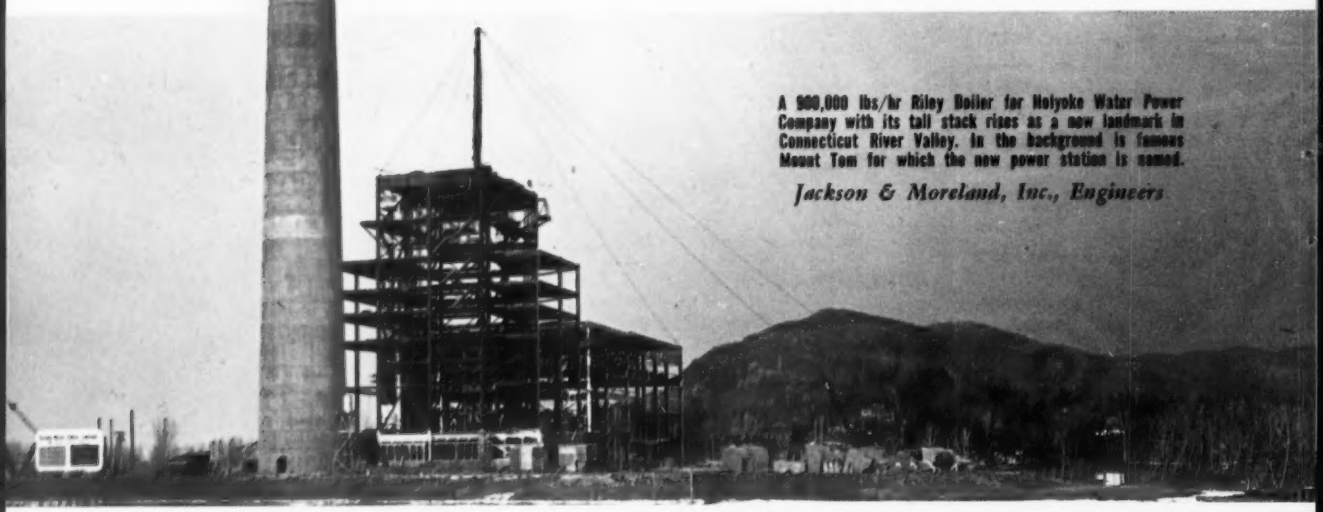
RILEY CENTRAL STATION UNITS

Landmarks From Coast to Coast

A decade of growth of the electric power industry and of Riley Stoker Corporation, one of America's leading suppliers of steam generating and fuel burning equipment, is symbolized in these Central Station installations and customers — representing a few of the many Riley Central Station Boilers that have been installed in this period of great expansion.

Now, a new era of growth is here. New Riley boiler designs and fuel burning techniques will provide the high degree of dependability and efficiency required.

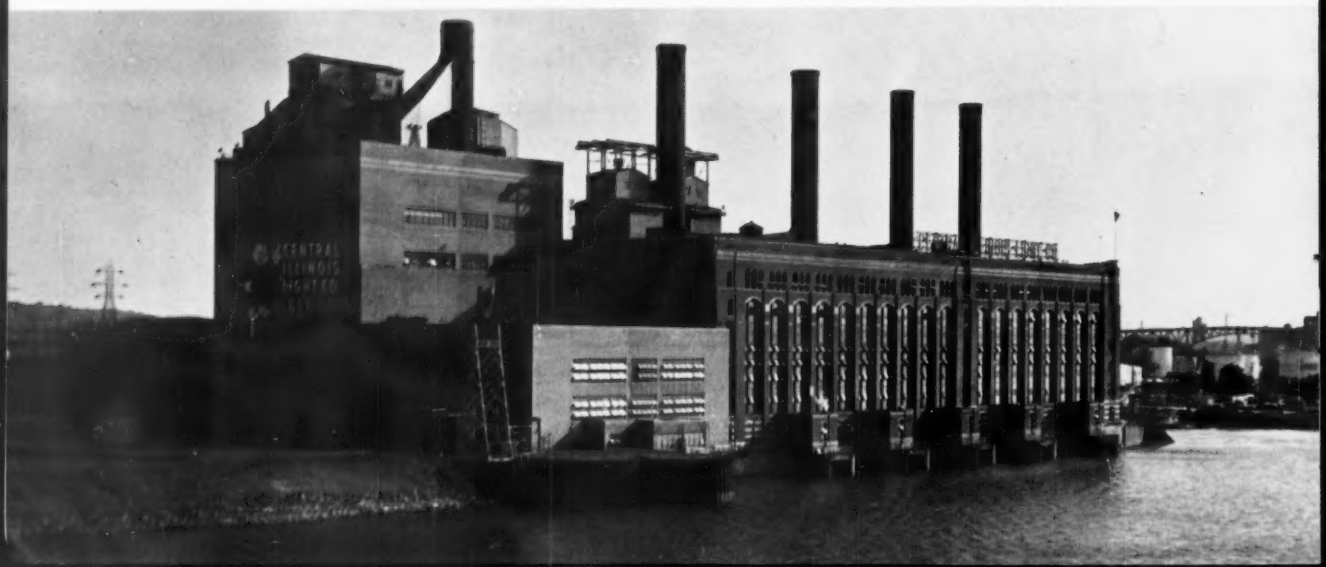
For details on the latest Riley developments consult your Riley representative.



A 900,000 lbs/hr Riley Boiler for Holyoke Water Power Company with its tall stack rises as a new landmark in Connecticut River Valley. In the background is famous Mount Tom for which the new power station is named.

Jackson & Moreland, Inc., Engineers

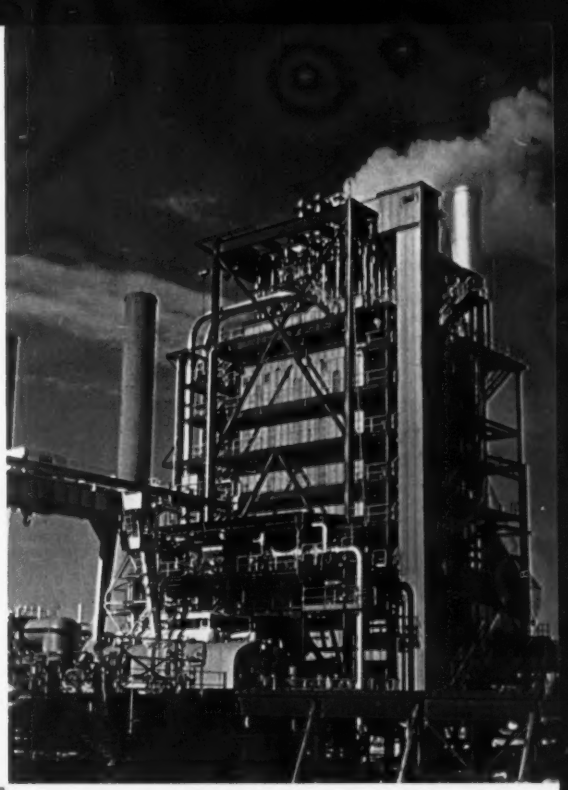
Below — Central Illinois Light Company's R. S. Wallace Station has had Riley Units installed since 1939. The latest is a 690,000 lb/hr Riley Reheat Unit. Another Riley 825,000 lb/hr Unit is being installed at LaMarsh Station. ***Commonwealth Associates, Inc., Engineers.***



A Few of the Many Public Utility Companies That Are Using Riley Steam Generating Equipment

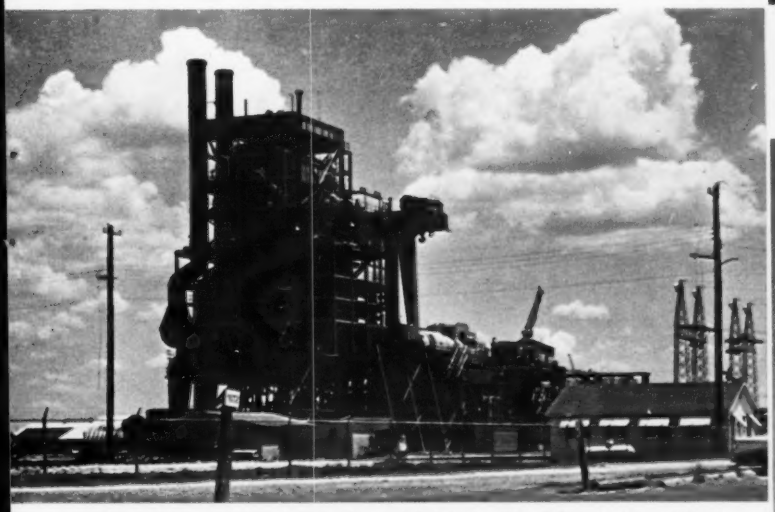
Houston Lighting & Power Co.
New Orleans Public Service Co.
Monongahela Power Company
Southwestern Gas & Electric Co.
Public Service Co. of Indiana, Inc.
Columbus & Southern Ohio Electric Co.
South Carolina Electric & Gas Co.
Northern Virginia Power Co.
Southwestern Public Service Co.
Union Electric Co. of Illinois
Taiwan Power Co. (Formosa)
Iowa-Illinois Gas & Electric Co.
Montana-Dakota Utilities Co.
Delaware Power & Light Co.
Minnesota Power & Light Co.
Central Louisiana Electric Co.
The Hartford Electric Light Co.
Manila Electric Company
Union Electric Co. of Mo.
Ohio Edison Company
Public Service Electric & Gas Co.
Dallas Power & Light Co.
Texas Electric Service Co.
Louisiana Power & Light Co.
Potomac Edison Co.
West Penn Power Co.
Arkansas Power & Light Co.
Utah Power & Light Co.
Florida Power Corporation
Florida Power & Light Co.
Central Illinois Light Co.
Southern Nevada Power Co.
Northern States Power Co.
Commonwealth Edison Co.
Gulf Power Co.
Pennsylvania Electric Co.
Interstate Power Co.
Philadelphia Electric Corp.
Kansas Gas & Electric Co.
Pacific Gas & Electric Co.
Holyoke Water Power Co.
Mississippi Power Co.
Worcester County Electric Co.

A survey of your plant by qualified consulting engineers could show ways of making substantial savings in your power costs.

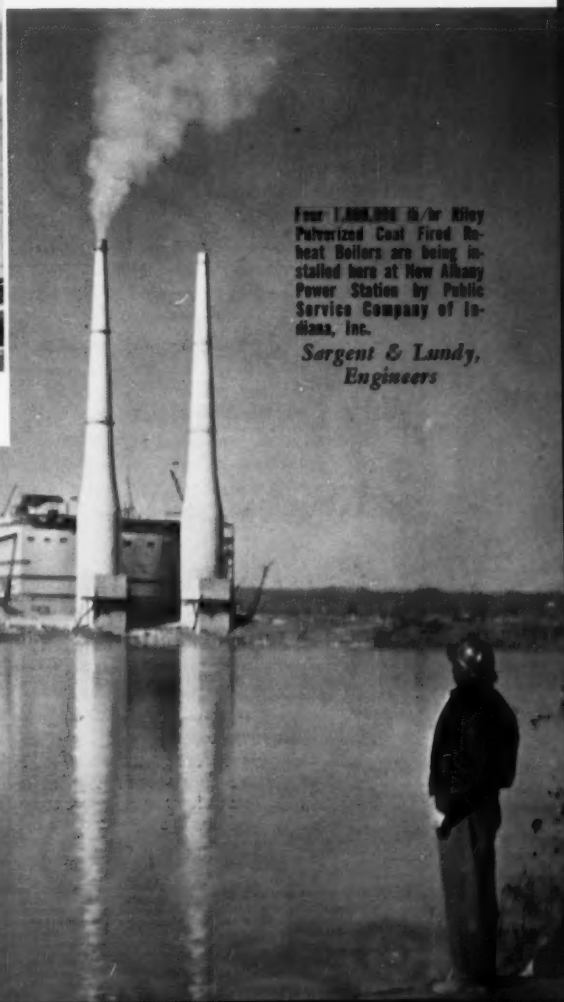


Above — The 870,000lb/hr Riley Turbo Furnace Unit at the Permian Basin Steam Electric Station of Texas Electric Service Co. which has two other Riley Units in its system.

Ebasco Services, Inc., Engineers



Houston Lighting and Power Company has installed twelve Riley Boilers in the past twenty years. Here is a recent installation at the North Houston Steam Electric Station.



Four 1,809,000 lb/hr Riley Pulverized Coal Fired Reheat Boilers are being installed here at New Albany Power Station by Public Service Company of Indiana, Inc.

Sargent & Lundy, Engineers

RILEY

STEAM GENERATING & FUEL BURNING EQUIPMENT

RILEY STOKER CORPORATION, WORCESTER, MASS.

Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Jacksonville, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, Seattle, St Louis, St. Paul, Syracuse, Worcester.

This simple trap operating principle provides the efficiency, dependability and freedom from maintenance necessary for the most profitable use of steam

When trap is first installed, the inverted bucket is down and the valve is wide open.

When steam is turned on, condensate (solid color) flows into trap and out through discharge orifice, until —

Steam (light color) reaching the trap floats the inverted bucket and closes the valve.

When more condensate enters the trap, the bucket loses buoyancy and pulls on valve lever.

When weight of bucket times leverage overcomes pressure on valve, bucket sinks and opens trap.

Key: condensate steam steam bubbles air bubbles

ARMSTRONG INVERTED BUCKET STEAM TRAPS

are designed and made to give you these big benefits:

● Amstrong Traps, the first inverted bucket steam traps, now represent the most advanced development of this time-proven principle. They provide all the advantages necessary for efficient, economical condensate drainage from virtually all types of steam using equipment.

1. *No steam loss* – Steam never reaches the orifice even when there is no condensate load.
2. *Automatic air elimination* – Vent in trap bucket passes air and other non-condensibles through to be discharged with condensate.
3. *No cooling leg required* – Condensate is discharged at steam temperature as fast as it reaches the trap because trap operates on difference in density between steam and water not on temperature.
4. *Operates on any back pressure* – Failure of one trap in system will not cause others to open because high back pressure does not affect an Armstrong trap other than to reduce capacity. As long as there is a pressure differential across the orifice the trap will close on steam and open for condensate.
5. *Unaffected by ordinary dirt* — Swirling action of condensate keeps dirt in suspension until discharged with condensate, prevents it from lodging in valve.
6. *Completely dependable* — Proved design plus the use of all stainless steel working parts assure continuity of service and length of service unmatched by any other trap.
7. *Big capacity in a small, economical package* — Armstrong design gives you the highest practical capacity for any given pressure. And remember, Armstrong capacity ratings are based on *hot* condensate at the *working pressure differential* stated, not on theoretical orifice capacities.

Further information on these advantages plus much additional information is given in the 48 page Armstrong Steam Trap Book. Ask your local Armstrong Representative or write direct.

860 Series for low pressure heating service.

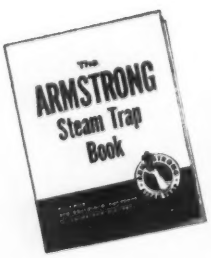
800 Series, side inlet, side outlet.

No. 801, side inlet, bottom outlet.

880 Series, integral strainer.

200 Series, bottom inlet, top outlet.

Forged Steel Series for high pressures, high temperatures.



The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

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Power reports on . . .

Central Station Design

Development work and proving out ideas at the pilot-plant stage were significant activities in power generation. Work continues in basic research to meet distant future needs

Steam power

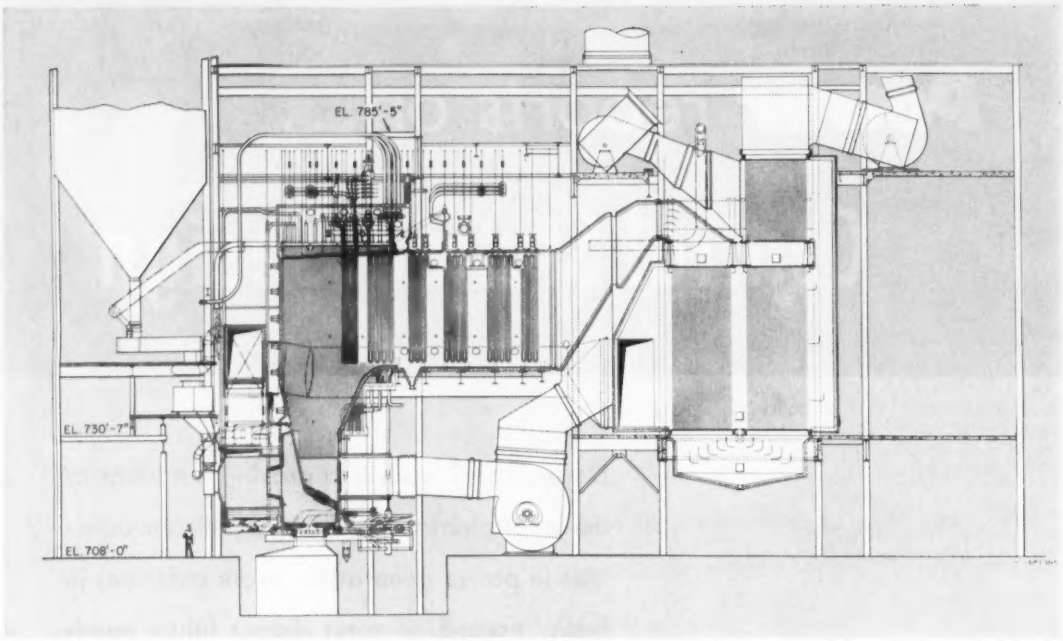
Fuel conservation to offset rising prices in power generation can be accomplished by striving for higher thermal efficiency. But this is practical only when capital charges on complex equipment are less than the fuel saving. Similarly, rising labor costs and increased complexity of equipment accelerate the trend toward full automation in power plants. High-cost equipment today needs fast, safe, accurate controls. **page 164**

Nuclear power

None of today's designs offer nuclear power plants that can compete economically with conventionally fueled generating stations. But uranium-powered stations do offer advantages for special situations, mostly military, that alone make development worthwhile. Steady progress in development of fuels and reactors gives substantial hope that atomic power will eventually produce economic civilian power. **page 170**

Peaking power

Advancing technology makes many of today's electric-utility systems run at high thermal efficiency. Continued growth in energy demand calls for installing more and more capacity. These high-efficiency systems must now choose between high-cost high-efficiency new plants or low-cost low-efficiency peaking plants. There's no pat answer as to which is best—system planners must make thoroughgoing studies. **page 178**



UNIVERSAL-PRESSURE STEAM GENERATOR of Unit 6 at Philo Station of American Electric Power Co, Inc is fired by three cyclone furnaces and has two stages of reheating. Gas-recirculation fan helps to control superheats and slagging

Philo 6 produces design data as well as mwhr

With today's multimillion-dollar investments we take the prudent course by proving out pioneering ideas in pilot plants. Thirty-month pilot run of superpressure plant pays off at Philo Station

Interest continues to focus on the first supercritical pressure unit, Philo 6, of the American Electric Power Co that started running March 20th, 1957. Operating experience here lays the foundation for units of this class soon to follow. Philo 6 has a cyclone-fired once-through steam generator supplying 4500-psig 1150/1050/1000-F steam to a 120-mw tandem-compound turbine driving a 3600-rpm direct-cooled generator. Design steam flow for Philo 6 is 675,000 lb per hr to the turbine throttle.

Few of the outages of the unit can be attributed to the supercritical-pressure feature. Here's an abbreviated rundown on operating experience since the unit started, some of the operating troubles experienced and steps taken to correct them.

Bypass system. Discharge sections of the turbine-bypass valves were severely eroded by recirculation of cold water during the preliminary startup. Redesign eliminated sharp changes in the valve contours and adding stellite gave protection.

Similar troubles and corrections were experienced with the superheater-bypass valves. Subsequent operation has proved the bypass systems.

Turbine-sealing steam. Turbine-seal steam originally taken from inlet of the h-p flash tank was moved to the h-p flash-tank vapor outlet and finally supplemented by a downstream tap after No. 1 turbine-bypass valve. Flash-tank source is used during cold startup and the downstream tap serves as turbine-seal steam source during hot restarts.

Boiler-feed pumps. Pump sealing has given considerable trouble that cannot be attributed to supercritical pressures. Flashing near the outer end of the h-p pump bushings was believed to be the cause of their repeated failures.

New design of h-p pump seals uses an inboard

seal-water injection directly from the l-p pumps. Elimination of flashing has improved performance. Work continues in developing a satisfactory seal.

Feedwater heating. Original steam generator design specified 525-F feedwater temperature. Operation has shown that using 565-F feedwater keeps the transition zone nearer the design position in the unit. Higher feedwater temperature improves the heat rate at expense of a 5-mw loss in capacity. The temperature can be controlled to take advantage of improved performance or maximum capacity as needed.

Iron oxide. After initial cleaning and operation of the plant system the major source of iron oxide was found to be rust in the condenser shell. As the rust was scrubbed off by steam from the flash-tank system this contamination decreased.

Iron oxide at the superheater outlet stays relatively constant at two to four ppb for widely varying input levels to the steam generator. Most of the oxide is deposited in the boiler tubes before the outlet of the primary superheater.

Initial operation of the unit showed need for adequate filter capacity to avoid fouling the steam generator with high iron concentration in the feedwater during (1) initial cleanup and (2) return to service following extended outages. Contaminated drains need to be isolated and filtered before reinjection into the main cycle during startups.

Performance. Tests of the plant showed substantial realization of design performance:

Item	Design	Test
Turbine heat rate, Btu per kwhr	7173	7168
Boiler efficiency, %	89.3	89.44
Auxiliary power, %	8.3	10.5
Plant heat rate, Btu per kwhr	8759	8954

Poorer-than-design feed pump performance and higher-than-design speeds for the recirculating fans of the steam generator account for the higher auxiliary power demand.

Cyclone furnace. During early operation a few tubes in the cyclone furnaces developed leaks where casing was plug-welded to the tubes. These leaks were in cyclone's front cone section, in the lower part of the barrel section and in the zone of the heavy support collars. The leaks were caused by differential expansion between pressure parts and casing, and took the form of small holes where the tube metal had been pulled out by the relatively thicker and more rigid casing. These were strictly mechanical failures and had nothing to do with the steam conditions of the unit.

Startups. In a cold startup a minimum of 225,000 lb of feedwater per hr flows through the turbine bypass system at a pressure of 3500 psig. A gas-tempering fan is placed in service and the gas-proportioning dampers are closed on the reheater side. One cyclone furnace is fired to raise the outlet fluid temperature at a rate of 200 F per hr.

Outlet temperature is held at 500 to 550 F until water's iron content drops to ten ppb or less. Then after raising the outlet temperature to 850 to 900 F the turbine is rolled. Time from lightoff to turbine rolling usually runs from 3½ to 4 hr.

In hot restarts the water or steam flows through the superheater bypass instead of the turbine bypass. When fluid temperatures stabilize, flow is transferred from the superheater bypass to the turbine bypass. Reheater is protected against overheating by closing the reheater gas-proportioning dampers and controlling the gas temperature entering reheater until turbine rolls and steam passes through the reheater. During hot restarts the turbine may be rolled within an hour after lightoff and the unit loaded in another 15 minutes.

Rate of temperature rise is limited by turbine-stop-valve austenitic wall thickness and turbine-bypass-valve wall thickness. The 200-F-per-hr rate creates a temperature difference of about 42 F across the 2¾-in.-thick wall of the reducing-valve casing. This produces a compression stress of about 18,000 psi. Plastic deformation from this stress should allow at least 1000 cycles before cracking appears. All other parts of the boiler, piping and turbine shell can be heated at rates higher than 200 F per hr.

Steam generator. There had been some plugging of the gas-tempering ports. This affects both gas and steam temperature distribution and balance. Little unbalance can be tolerated in steam temperature at the 1150-F level. Modifications explained later prevent the port plugging.

At full load of 675,000 lb per hr the pressure drop through the unit is 70 psi less than the expected 950 psi. Lower fluid temperatures in cyclone furnaces and primary superheater, as well as excellent internal surface condition of the tubes and extremely close manufacturing tolerances contribute to the lower pressure loss.

H-p austenitic rotor. The austenitic rotor of the h-p turbine was chosen for study, to learn how it behaves during starting and rapid load changes. Rotor-cooling system intended only for the ferritic rotor was put into service with the austenitic rotor to explore its effectiveness. Though working perfectly, the cooling system has since been eliminated by installing new nozzle boxes and 1st to 3rd stage buckets. This improves net heat rate by 23 Btu per kwhr.

Uniformity of heat flow in or out of the austenitic rotor fully equals that of a ferritic shaft. The austenitic rotor will probably see permanent service.

Turbine bearings. Because of the small length-diameter ratio of the h-p rotor, bearings were made of the pivoted shoe design. Within a week of running at full temperature the babbitt and steel backing of the bottom of both bearings had cracked.

To correct this condition, ferritic sleeves were shrunk on the austenitic rotor to act as the journal. The sleeve introduces a temperature difference between shaft and oil film causing the 18-8 part of

shaft under the sleeve to run at somewhat higher temperature than a conventional solid journal. Coefficient of expansion of 18-8 material is about 30% greater than conventional ferritic journals.

Turbine thrust. Late in 1957 measurements showed that the thrust was about five to six times higher than design. Turbine-efficiency measurements showed a drop of about 6% in the h-p element since the unit started.

When turbine was taken out of service for an extended inspection at the end of May, 1958 the h-p turbine buckets and diaphragms had heavy deposits. They began at the 3rd stage and increased in thickness to the 11th stage. The deposits were black, adherent and hard at the 4th and 5th stages and "loosely flakey" beyond. Deposits varied in thickness from the leading to the trailing edges of the nozzles.

In the first reheat turbine a very slight brownish deposit was found on the convex sides of the 14th and 20th stage buckets. In the second reheat turbine there were hard, adherent black deposits on the underside of the shroud bands on all stages.

Analyses of the deposits in the h-p turbine showed them to be about 95% cuprous and cupric oxides. About 3 to 8% was magnetic iron oxide, and silica and metallic oxides were less than 0.1%. Cuprous oxide, Cu_2O, predominated over cupric oxide, CuO.

Deposits in the 1st reheat turbine were a mixture of ferric and magnetic iron oxides, together with cupric oxide. Ratio of iron oxide to copper oxide ranged from one to two except for the 15th stage where CuO was the major constituent.

Deposits in the 2nd reheat turbine had iron oxides ranging from 75 to 90% and copper oxides ranging from 4 to 23%.

In searching for the source of this material one tube in the second reheater was found covered with a thin film of red rust.

Test program. The copper deposition needed to be minimized, so a two-part test program was devised. (1) Chemically, the copper pickup should be minimized and any carryover should be made to deposit within the steam generator. (2) Mechanically, the rate and extent of copper deposits must be found.

In general the major source of copper pickup appears to be in the water side of the h-p heaters. The pH level of 8.7 with ammonia has given the best overall results in minimizing pickup.

Ratio between dissolved and suspended copper appears to be about two for both condensate and feedwater. But amounts of insoluble copper at the secondary superheater outlet appear consistently in the range of 0.5 to 2 ppb, irrespective of total copper content. Whether this represents a solubility change or a smaller particle which passes the Millipore Filter is not known.

Copper buildup in the turbine continues to be a problem. Minimum copper concentration is established in the cycle during startups before placing the tubine in service; this prolongs startups to as much as three days.

Main steam leads. Cracking was found in essentially all attachment welds to the Type-347 stainless steel main steam piping. But there was no indication of cracking in the main butt welds.

Hanger lugs were eliminated and replaced with conventional clamp type supports. At the two support points on vertical piping, four small lugs were welded to the pipe to take the load in shear. All radiograph-inspection plugs were moved from the pipe and the holes partly filled with stainless-steel plugs and finished off flush with weld metal. Where possible, instrument connections were eliminated and repaired as above. In all other cases cracks were ground out and rewelded.

Turbine stop valves. These valves developed radial cracks in the stellite portion of the integral seats that progressively increased in length, enlargement and number. A modified screwed-in replaceable seat was installed—this was done with special tools with the valves remaining in place.

Steam-generator welds. Cracking of several dissimilar welds in the connecting pipe between the platen-superheater-outlet and secondary-superheater-inlet headers was discovered in early 1958. It seemed that change in cross section from 4½-in. to 5-in. dia at the weld was concentrating stresses at that point and inducing cracking. Shop-fabricated "dutchmen" of 5-in. dia containing the dissimilar welds were welded to the headers, moving the section reduction and stress concentration farther away from the headers. These have worked satisfactorily up to the time of this report.

Furnace slagging. Slag has accumulated at the junction of the secondary furnace roof and platen superheater. Large masses of slag falling on the screen tubes below have distorted them. Additional retracting slag blowers increased the coverage of the platen superheater area, but slag still forms. Screen tubes were pulled back into place and the ties in the tube bundles extended to give more rigidity.

Slag also forms at recirculating-gas ports near the back of the furnace pass. The ten individual ports cannot be easily seen so slag conditions must be interpreted from furnace performance. Of four different types of slag blowers tried none was wholly satisfactory. Further study is now being carried on.

During sustained runs of the unit flyash accumulated on the floor of the convection pass. Accumulations were deep enough to cover the lower three to four ft of the superheater and reheater loops.

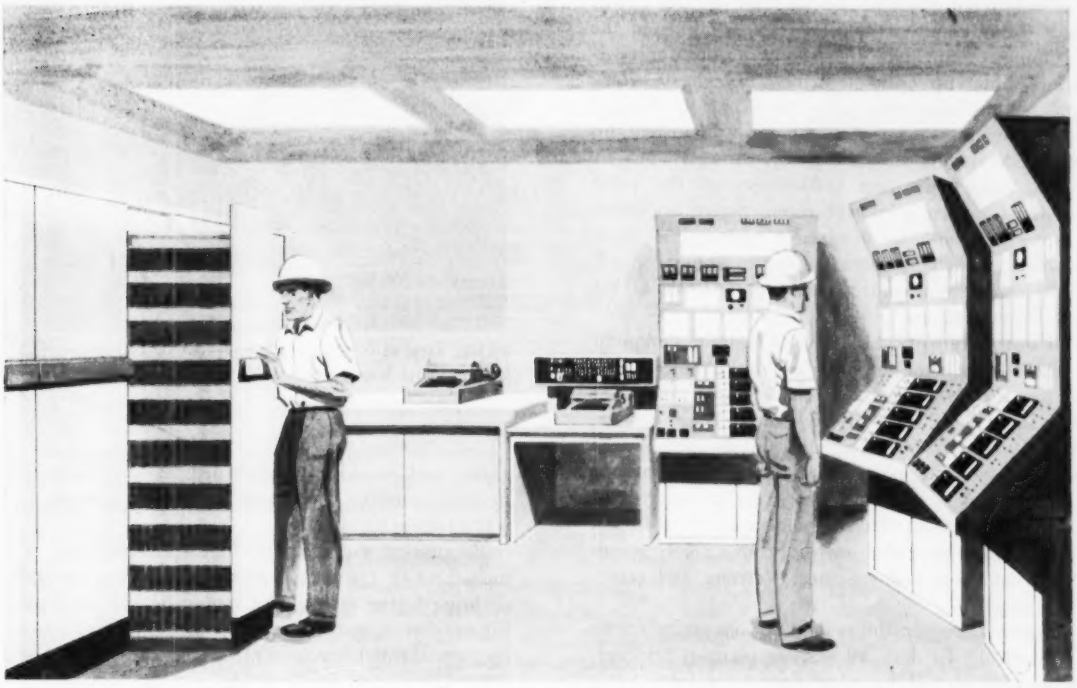
A manually operated blower was installed to move the ash up the inclined duct. Hoppers installed at the convection pass outlet have been completely successful—no flyash has accumulated there after a continuous run of 2300 hr.

Summary. Only the more important experiences with Philo 6 are reported here. Attention has been

focused on establishing minimum copper concentrations in the cycle before starting the turbine. Until corrective measures are found, startups will continue to be of two to three days' duration.

Outages for remedial purposes were anticipated from the start of the project. These were significant in fixing size of the prototype unit. System conditions allow extending this outage to avoid undue overtime costs. Lessons learned from Philo 6 prove valuable in the design of the two 450-mw units being installed at Breed and Philip Sporn plants of American Electric Power Co.

This article is abstracted from "The second year of operating experience with the Philo supercritical-pressure unit" by Frankenberg, Lloyd and Morris of the American Electric Power Service Corporation, published in the 1959 *Proceedings of the American Power Conference.*



MODERN CONTROL ROOM design reduces clutter. Panels concentrate instruments for use when off computer control

Operating safety shapes today's control systems

Central-station control and instrumentation continue to pace the power industry. But basic forces affecting development of new designs have changed. For years the primary goal of control was higher efficiency. Today increased efficiency is still an important goal, but the size and complexity of modern plants turns safety into a major problem. It is physically impossible for even trained operators to control or supervise a 500-mw unit with *guaranteed* safety, and the penalty for a single error is becoming financially prohibitive.

As a result, 1959 saw installation of several complex data-logging and safety systems and plans announced for two computer-controlled plants. In each case operating safety was a major factor in justifying the cost of such a complex system.

How are these systems justified?—by direct or indirect operating savings. A modern boiler will burn upwards of five million dollars in fuel annually. Computer control or data-logging systems are conservatively credited with increasing plant efficiency by an average of ½%. This would mean direct fuel savings of at least $25,000 per year, equivalent to $300,000 in capitalized cost. At the same time big units mean increased damage from even minor accidents. Limited-accident costs may run about $180,000 while a major accident to the same unit probably would cost up to two million

dollars. On this basis prevention of one major accident would more than pay for the most complete control, data-logging and safety system.

As plants with 500-mw units go into operation, control rooms of the general type shown on preceding page may become the rule. Compact boiler-turbine-generator control panels place all necessary indicator and control functions within instant reach of plant operator. Computer brain, housed in pull-out racks, would actually control operation of units. But operator takes over during infrequent computer outages or cases of emergency.

Uncluttered effect of one of these control rooms is a direct result of data-logging functions in the computer. Plant data not directly needed for operation shows up only on printed log sheets. This one feature inherently promotes safety by concentrating operator's attention on most important instruments during any emergency.

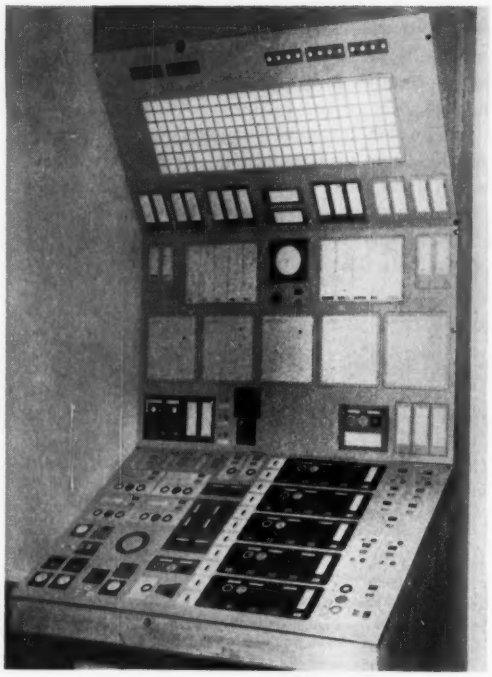
To refine operating instruments to the point needed for such a control room, design engineers place great emphasis on systems engineering. Basic systems analysis has been applied to boiler control, turbine-generator control, etc. But analysis of the whole cycle at one time is infrequent.

First attempts at fully automatic computer control have superimposed an optimizing system on top of conventional control. At Louisiana Power and Light Co's Little Gypsy Station (see POWER, May 1959, p 64-65) computer adjusts set point of standard control loops. For start-stop operations, Little Gypsy's computer performs a programed interlock function which sequences all steps in hot or cold startups or shutdowns. From a safety standpoint computer assumes most warning and safety trip functions.

Operating responsibility does not rest entirely with the control. To date, all systems planned for computer control will *augment* operator's job. Automation will do the jobs it does best: run-of-mill calculation for control adjustments, arbitrary safety trips and programed series of simple operations. Operators are freed from split-second actions and allowed to concentrate on operating decisions only the human brain can make.

Second computer-controlled unit will go into service at Southern California Edison Co's Huntington Beach Station. System again consists of optimizing control superimposed on basic system, automatic startup and shutdown on a pre-programmed basis. But all similarity ends here. Huntington Beach Station will operate as a subcritical, once-through cycle with controlled turbine bypass included in startup and shutdown programing.

Computer control will be called upon to operate this unit for optimum valve-point loading. To do this designers are taking advantage of one of the once-through steam generator's best characteristics. Boiler pressure will vary with load, allowing turbine throttle valves to maintain fully open or fully closed position over most of the load range. This is easily and quickly accomplished in once-through units by varying feed-pump discharge pressure as a function of turbine load.



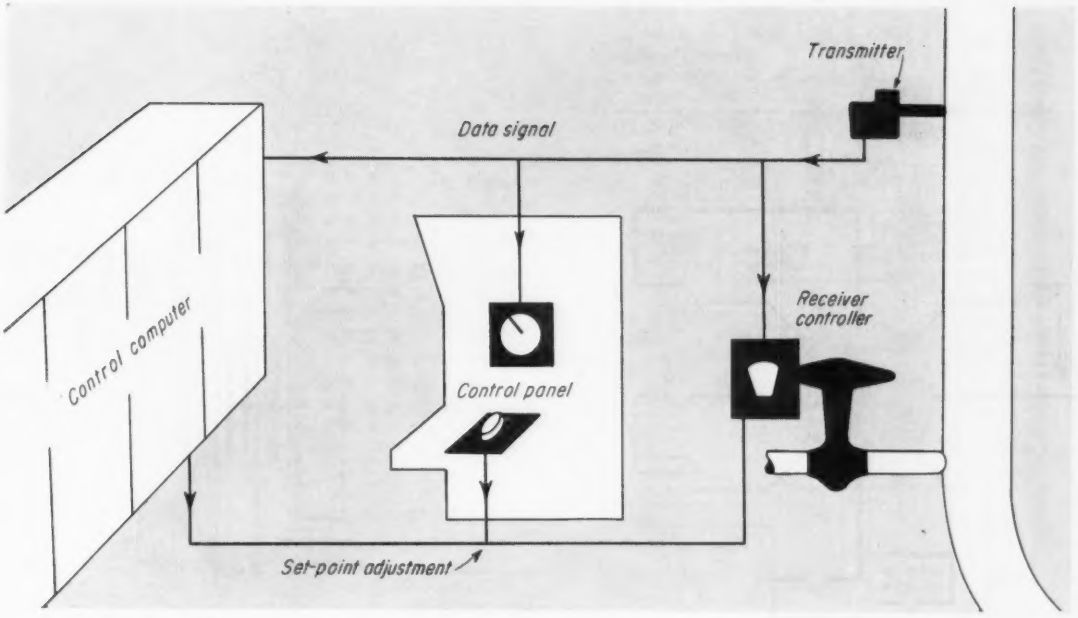
PANEL MOCKUP follows current trend to compact control layout. Panel houses control for boiler, turbine, generator

Because of the basically high-speed response of once-through cycles, computer control is a natural addition to the system and should be able to show big savings in startup or shutdown costs. For more on once-through cycle control, see POWER's April 1959 *TD* report, *Supercritical pressure control.*

Trend continues beyond control of individual units to automatic load dispatching for an entire system. As an example of current dispatching units, Commonwealth Edison Company has installed an automatic system which exactly regulates production in ten generating stations. Cost, including installation expense, approximated $700,000. System regulates electrical output to match demand and selects which of 37 turbine-generators can most economically produce electricity as needed.

Equipment continually determines the incremental amount of generation needed and instantly translates it into a cost-of-power bid. This bid is transmitted to the generating stations where similar control equipment assigns load to units which can produce power at this cost.

Computer determines which turbine-generators can carry a given electrical load most economically on the basis of individual unit efficiency, fuel cost and transmission cost to the point of use. Since some of the stations are up to 140 miles away transmission cost is a big factor in overall operation.



SHORT LOOP CONTROL uses local receiver-controller concept with computer and BTG panel in parallel to trim controls

Dispatcher will not only be valuable in assuring the most efficient use of power production facilities, but will also maintain proper flows on interchange of power between Commonwealth Edison and the other utilities with which it is connected. This factor is important because of the huge power pool in the east-central part of the United States. Smooth operation of the pool requires that each of the interconnected utilities be responsible for its own requirements.

Present automatic dispatching systems base their incremental cost figures on predetermined performance curves for each unit cycle. Although this is an excellent first step, ultimate plant data-logging systems will supply automatic dispatching equipment with up-to-the-minute values of cycle efficiency under existing conditions.

When a heater trips out, turbines foul or any other of the myriad problems which happen each day crops up, data loggers report a corrected heat rate. Under these conditions the entire utility system is balanced for optimum performance.

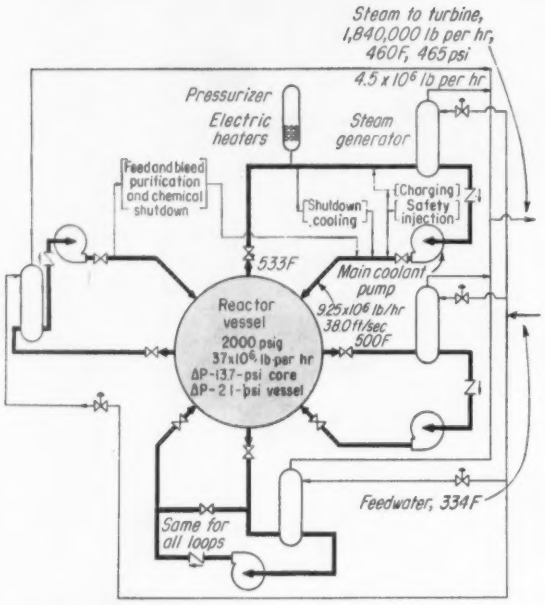
Control panels for latest units represent the continuing effort to trim instrumentation down to bare essentials. To do this, plant-design engineers and control manufacturers have given much time and effort to research in human engineering.

One example of this is the final mockup of a complete boiler-turbine-generator control panel for a coal-fired unit, facing page. Panel design resulted from a long development program by Ebasco Services Inc, consulting engineers for the plant construction. This is not an overnight development program; Ebasco engineers have evolved this basic design over a period of years to fill their need for complete centralization of boiler-turbine-generator controls. Nicknamed BTG panels, control units are designed to put a single operator within one step of all controls normally requiring manipulation. All indicators which must be in constant view of operator are included in the upper portion. Wherever possible, indicators are replaced by annunciators which actually foster quicker reaction to trouble than recorders. Function lights also serve this purpose, showing on-off condition of equipment.

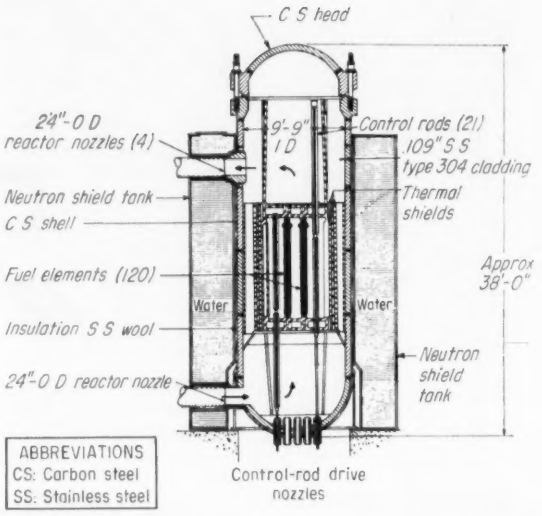
This type of panel is not limited to plants having computer control or data-logging systems. The great majority of BTG panels are installed in conventional control rooms, with incidental control and indicating instruments located in adjacent panels or cubicles outside basic operating area. This application is consistent with the concept of compactness for safety's sake in any large installation.

Various design engineers approach the problem of control layout from different directions. Prime factors they keep in mind are (1) a practical balance between simplicity of operation and minimum first cost and (2) adequate safety features without encumbering operator's right of judgment.

Closed loop control on local basis places BTG panel and computer control on common line as set point adjustors, drawing, above. This arrangement will undoubtedly continue as the standard until computer control characteristics are better known.



YANKEE ELECTRIC plant uses four coolant loops with pressurized-water reactor to feed saturated steam to a 145-mw turbine



INDIAN POINT pressurized-water reactor has UZr fuel elements surrounded by thorium-oxide blanket for U-233 fuel breeding

Nuclear power plants go through intensive

While early plants put on encouraging performance, newer types are built and proposed and fusion gets attention

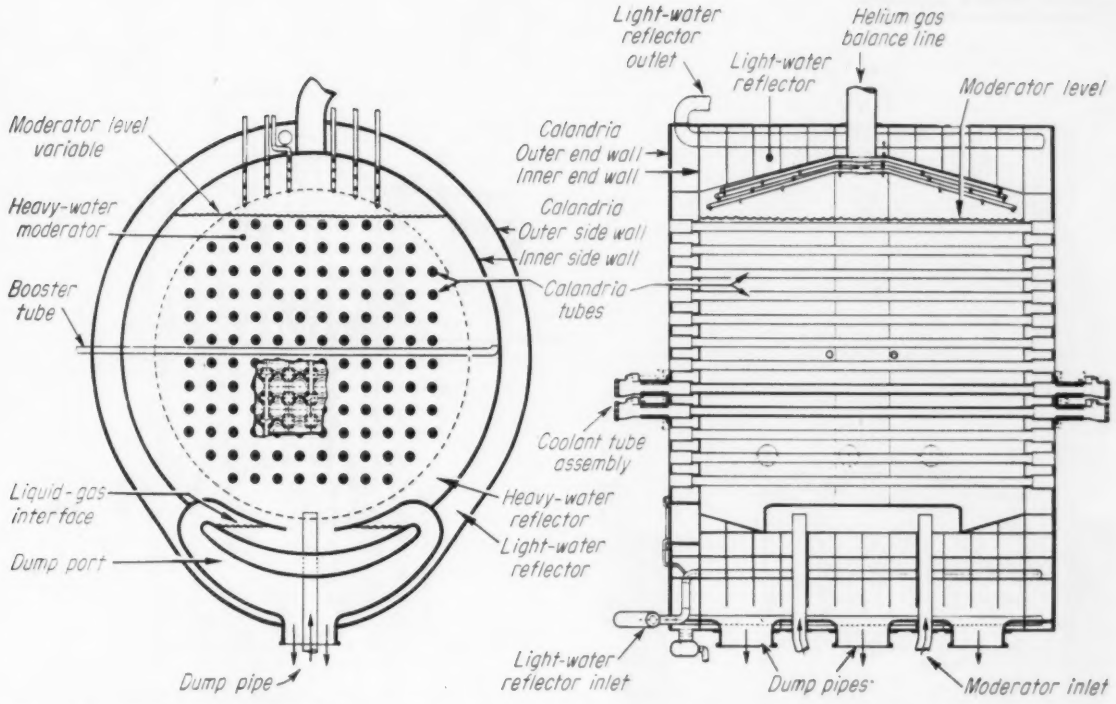
As the first stationary nuclear power plants were completed and went into operation during 1957 and 1958 the grim facts about installation costs began to emerge. Substantial rise of actual costs above original estimates inevitably pushed realization of economic atomic power further into the future, like an unattainable will-o'-the-wisp.

While a pall of gloom pervaded many professional nuclear meetings last year, some builders maintained that their estimates had proved realistic—but they never made their figures public. Their set prices obviously did not include all research and development costs. Extensive R&D costs are bound to make low-cost nuclear power difficult to realize soon. The way these costs are amortized by builders will help set the time scale for achieving competitive standing with conventional plants.

A tour of nuclear establishments today shows designers busily improving nuclear-plant components on the basis of data from the operating reactors, their confidence in eventually attaining economic power unshaken. Their progress depends on painstaking analysis, investigation and development rather than on any spectacular breakthroughs.

U.S. Atomic Energy Commission still acts as the prime mover in development of nuclear power in our nation. AEC's activity ranges importantly: into military applications as well as industrial, into mining and processing of nuclear fuels, into supply and application of radioisotopes, into basic and applied research and development. Overall it has the responsibility of enforcing safe practices in the handling of nuclear materials and of accounting for the full nuclear-materials inventory — which only the U.S.A. may own.

Naval Reactors Program. Perhaps the most important power applications have been in the Navy where pressurized-water plants have and will propel ships of several types, from submarines to destroyers and aircraft carriers. There are a total of 33 submarines operating, building and authorized. Three surface ships are abuilding—one of them, a carrier, will have eight reactors. Flexibility and cruising range of nuclear plants make them superior to conventional plants for military uses.

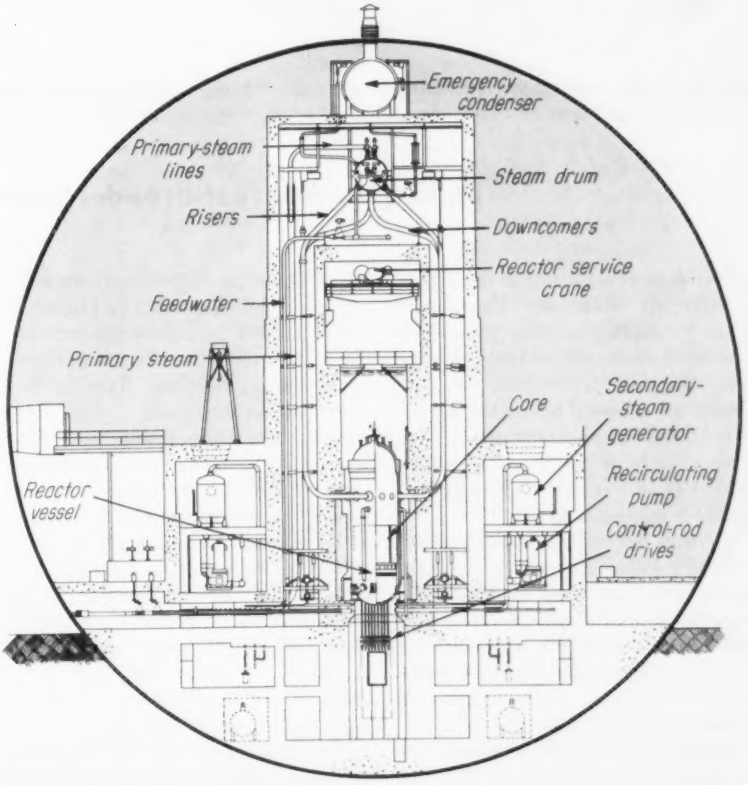


NUCLEAR POWER DEMONSTRATION reactor (NPD) of Atomic Energy of Canada, Ltd has pressure tubes for carrying heavy-water coolant, and unpressurized heavy-water moderator. Natural UO_2 fuel elements can be changed as reactor generates heat under load

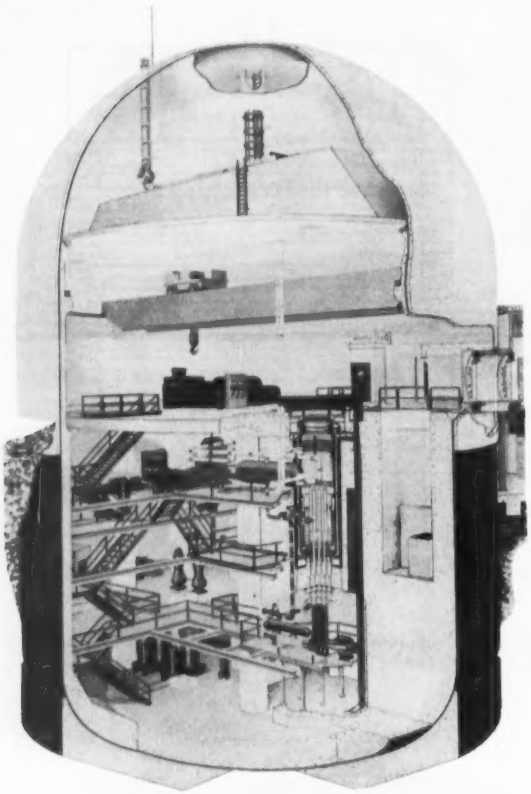
testing

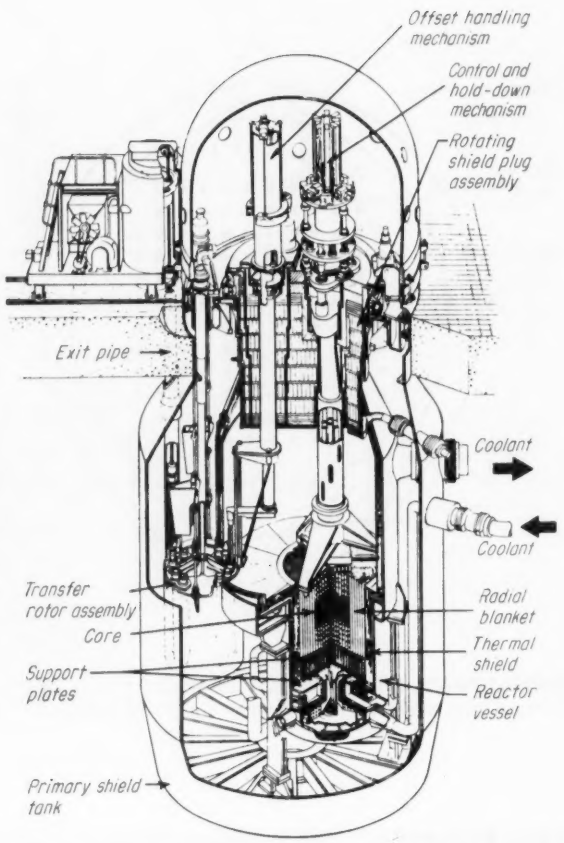
Several of these reactors have prototypes for development and testing at the National Reactor Testing Station in Idaho. They also serve as training devices for crews that will run the nuclear-powered ships.

Army Reactors Program seeks to develop stationary and mobile power plants for energy supply in remote areas. Design centers around making plant components transportable by aircraft and achieving the utmost in reliability. One design uses modular units that can be connected quickly in the field for operation, then later disassembled and flown to another site for service. The Army also endeavors to develop a truck-mounted plant. Table, p 190, includes some of these reactors that might also serve as small industrial



DRESDEN NUCLEAR POWER STATION has dual-cycle boiling-water reactor to generate steam at two pressure levels: (1) at reactor pressure (2) at lower level to flash steam





EXPERIMENTAL BOILING-WATER REACTOR at Lemont, Ill. developed over three times its rated design output, is being rebuilt

ENRICO FERMI FAST REACTOR uses sodium coolant for enriched uranium core and enriched uranium blanket for breeding

Boiling-water, fast-breeder, homogeneous reactor types

power sources sometime in the future.

Aircraft Reactors Program seeks to develop nuclear propulsion systems for aircraft, rockets and ramjets. No power reactor has yet propelled an aircraft or rocket in the U.S.A., but earthbound reactors have driven turbojet engines. Shielding proves to be one of the biggest problems for manned aircraft.

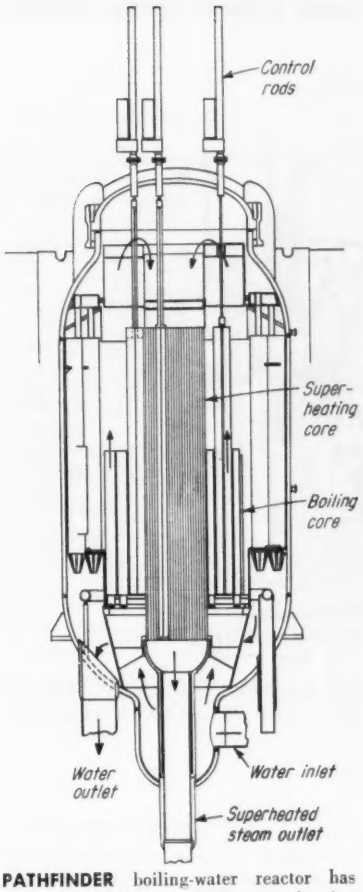
Systems for nuclear auxiliary power (SNAP) follow two lines of development. One developed by Martin Co uses the heat of a radioactive isotope for direct conversion to electricity. The other, being developed by Atomics International, uses a reactor to drive a generator.

Stationary atomic plants. Table of nuclear power plants, p 190, lists important projects already operating, abuilding and planned. This list does not include any overseas nuclear plants—mostly important in England. Eight or more of the foreign reactor plants will be built by American firms for Germany, Belgium, Italy, Switzerland, Japan and Cuba.

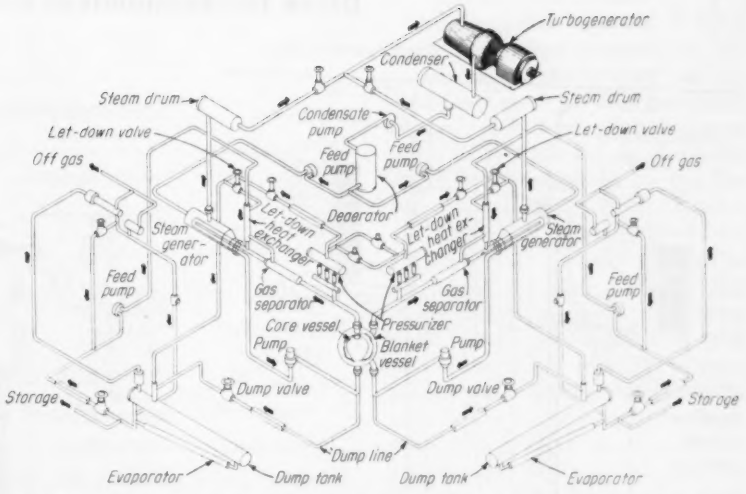
Table also ignores over 100 testing, research and training reactors, some of which have already been retired and dismantled. Most of these are small swimming-pool type units still to be built. But this group also includes such important units as CP-5 at Lemont, Ill., Materials Testing Reactor and Engineering Test Reactor at NRTS in Idaho and other privately-owned reactors for investigating materials under irradiation.

Reactor types. Seven basic types of reactors listed in the table emphasize the wide-open race for finding "best" types of reactors: (1) pressurized water (2) boiling water (3) fast breeder (4) sodium-graphite (5) organic moderated (6) gas cooled (7) homogeneous.

Since POWER's last *Modern Plant Survey*, October 1958, p 180-183, two nuclear power plants have been canceled. Estimated costs of the aqueous homogeneous reactor using a heavy-water moderator, to be built by Westinghouse Electric for Pennsylvania Power and Light Company, were giving it a low economic advantage compared to other nuclear plants so the sponsors decided to shelve it. AEC took a second look at the sodium-cooled heavy-water-moderated reactor intended for the Chugach Electric Association of Anchorage, Alaska and decided it was unwise to build an untried type at so remote a site—so it was canceled.



PATHFINDER boiling-water reactor has forced circulation, core for superheating



HOMOGENEOUS REACTOR EXPERIMENT-2 has two coolant loops: (1) supplied from central core and (2) supplied from blanket. Both coolants are heavy water carrying fuel

highlight program

National Reactor Testing Station. Much of the hardware phase of proving feasibility of nuclear reactors for heat and power production for the AEC and the armed services centers in the NRTS in Idaho. This isolated 894-sq-mile site allows testing reactors without endangering neighboring communities some 40 to 50 miles away. Station's permanent operating force totals about 4000, construction force averages 1000.

Seven contractors operate most of the facilities at NRTS: Argonne National Laboratory, Atomics International, Combustion Engineering, Inc, General Electric Company, Phillips Petroleum Company, Westinghouse Electric Corporation and Aerojet-General Corporation.

Scattered over the vast area of NRTS are 18 operating reactors and six under construction. The 18 running are: Boiling-Water Reactor No. 4 — BORAX-IV; Engineering Test Reactor — ETR; Experimental Breeder Reactor No. 1—EBR-1; Heat-Transfer Reactor Experiments No. 2 and 3—HTRE-2, HTRE-3; Materials-Testing Reactor — MTR; Organic-Moderated Reactor Experiment—OMRE; Special Power Excursion Reactor Test No. 1 and 3—SPERT-1, SPERT-3; Stationary Low No. 1—SL-1 (formerly ALPR); Submarine Thermal Reactor—S1W; Transient-Reactor Test Facility—TREAT; Large Ship Reactor—A1W (LSR); Critical Experiment—CET; Engineering Test Reactor Critical—ETRC; Hot Critical Experiment—HOTCE; Reactivity Measurement Facility at MTR—RMF; Zero Power Reactor No. 3—ZPR-3.

The six reactors under construction are: Experimental Breeder Reactor No. 2—EBR-2; Fast-Source Reactor — FSR; Gas-Cooled Reactor Experiment—GCRE; Large Ship Reactor B—A1W; Shielded Test (Pool) Facility Reactor — SUSIE; Special Power-Excursion Reactor Test No. 2—SPERT-2.

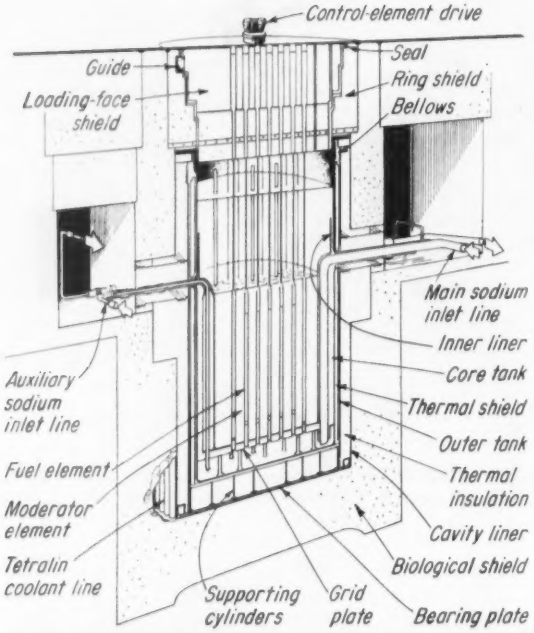
Power reactors at NRTS that could be important for civilian applications include SL-1, formerly the Argonne Low Power Reactor (ALPR). Originally designed and operated by Argonne National Laboratory it is now run by Combustion Engineering, Inc. This small 3-mwt boiling-water reactor plant could be used at remote outposts such as radar stations to supply electric power and space heating.

SL-1 will run three years on a single fuel loading. The plant components can be carried in Air Force cargo planes; no component weighs more than ten tons.

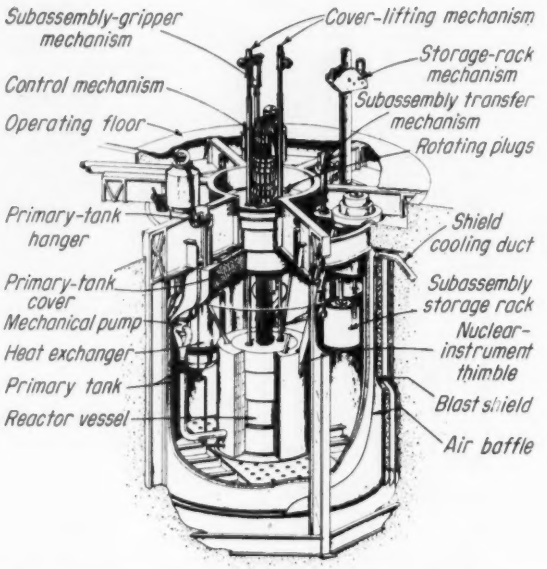
Gas-Cooled Reactor Experiment (GCRE) developed and operated by Aerojet-General Corporation will eventually power a portable closed-cycle gas turbine. As a first step the reactor now at NRTS receives pressurized nitrogen as the working fluid heated in an oil-fired heater. This simulates nitrogen that would be received from the regenerator in a closed-cycle gas-turbine plant. After further heating in reactor core to over 1000 F the N_2 throttles to a lower pressure and gives up its heat in an exchanger simulating precooler of the gas-turbine cycle. A centrifugal blower then repressurizes the N_2 before it re-enters oil-fired heater.

The gas-turbine elements are being developed at Fort Belvoir, Va. Specifications call for a plant to develop 400 kw with a thermal efficiency of at least 16%. The N_2 working fluid will enter the turbine at 1150 F and 212 psia; it leaves the turbine at 85 psia. Preliminary design uses a 2-

Drive for economical nuclear power generation



SODIUM REACTOR EXPERIMENT uses graphite moderator and sodium coolant to generate superheated steam for plant turbine



EXPERIMENTAL BREEDER REACTOR-2 has sodium coolant for enriched uranium core and depleted uranium blanket for breeding

stage centrifugal compressor and 2-stage axial-flow turbine mounted on a common shaft.

EBR-1, first reactor at NRTS, was first to demonstrate the principle of breeding in a natural-uranium blanket surrounding the core. The Mark II core of the reactor melted down in November 1955. A new Mark III core was installed in 1957. Plutonium fuel elements will soon be tested in the reactor.

BORAX-4, latest version of the boiling-water reactor series, ran with a core of uranium-thorium oxide fuel elements to demonstrate stable operation at higher temperatures and less reactivity with the water coolant when the cladding was ruptured. This plant is now shut down.

Next step contemplates BORAX-5 to test a core designed for nuclear superheating of the steam as well as evaporation of water coolant. This will be a rebuilding of BORAX-4.

EBR-2, now being built, provides a maximum of experimental flexibility by separating plant systems and yet allows checking feasibility as a commercial power plant that would be built to a more compact design. Initial core of the sodium-cooled plant will use enriched uranium but the next one will use plutonium. Plant incorporates a fuel-processing facility operating on a closed pyrometallurgical cycle. Plant will demonstrate operation of large-scale sodium components, such as pumps and heat exchangers, under high-performance pressures and temperatures.

OMRE, operated by Atomics International, went critical in 1957. This 16-mwt reactor dumps its heat to atmosphere through an air-blast heat exchanger. Moderator-coolant is *Santowax O-M,* a commercial mixture of ortho- and meta-terphenyls.

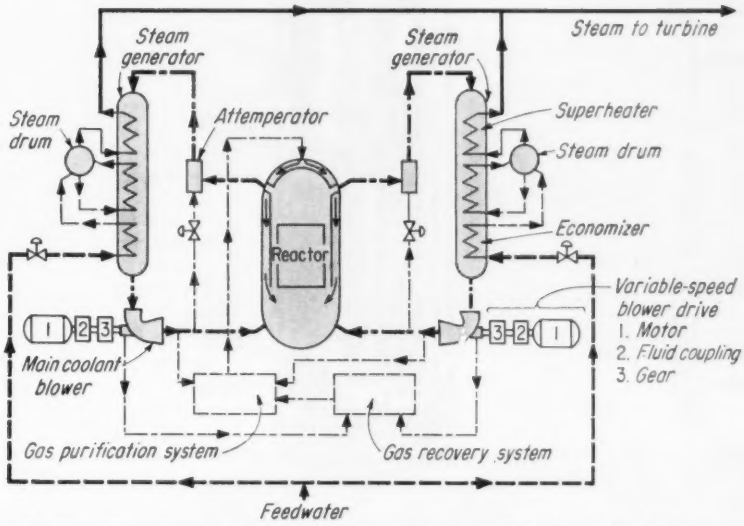
Reactor went critical September 17, 1957 and has generated more than 24,000 mwhr of thermal energy since. OMRE has had negligible fouling of heat-transfer surfaces. Radiation damage slowly decomposes the terphenyl used for moderator and coolant. In a commercial power plant the organic makeup would cost about 0.6 to 0.7 mill per kwhr.

The organic fluid has: (1) low vapor pressure at high temperature, 2.55 psia at 500 F (2) no corroding effect on most metals including uranium (3) low induced radioactivity (4) small neutron-absorption cross section and high hydrogen density (5) negative temperature coefficient of reactivity. Two fuel elements designed for the Piqua reactor and irradiated in the OMRE failed by overheating. Impurities plugged small coolant passages, preventing circulation. Coolant filters have been installed to remove impurities.

Atomics International and Bechtel Corporation made a study for AEC that proposed a 1013-mwt reactor cooled and moderated by *Santowax-R* to develop 300-mwe net. Organic at 36-psia pressure leaves the reactor at 675 F and returns at 550 F. Steam is generated at 615 psia and 650 F.

Core uses aluminum-clad UO_2 enriched to 2.5%. Anticipated burnup would be 15,000 mwd per ton of U. Reactor feeds four loops to carry heat to the horizontal boilers with the superheaters above the boilers. These steam generators deliver a total of 3,640,000 lb per hr to the turbine. At 14% capital charges and 80% plant factor the plant production cost in 1965 would be 8.1 mills per kwhr, including escalation and interest.

moves along many lines of development



GAS-COOLED REACTOR will have graphite moderator and helium coolant for low-enrichment uranium fuel. Two coolant loops will feed steam generators with superheaters

Pressurized water reactors. Propulsion plant for the submarine *Nautilus* laid the design principles for many of the PWR stationary power plants now operating and under construction, table, p 190. Shippingport, started up in 1957, is the largest PWR now running. It will soon be joined by Yankee and Indian Point, each of them successively larger in capacity.

These plants all use a single reactor core in a vessel cooled and moderated by light water pressurized to prevent boiling. After being heated in the reactor core the water flows through two or more forced-circulation loops, all in parallel, giving up some of its heat to generate steam in heat exchangers. Coolant then returns to the reactor vessel for another pass through the core to be reheated.

Latest PWR to go in service is the *N S Savannah* using 22,000-shp turbines taking saturated steam ranging from 430 psia at full load to over 700 psia at minimum load. The 76-mwt reactor plant, built by Babcock & Wilcox Company, holds 8060 kg of UO_2 enriched to 4.4% and clad with stainless steel. During a 3½-year operating period core will generate 52,000 mwd. This gives the ship a range of about 300,000 nautical miles at a speed of 21 knots.

Coolant circulates through the system at 1750 psia, entering the core at 494 F and leaving at 521 F. Two coolant loops carry the heated water to two steam generators; these normally supply all of the ship's power. During reactor shutdown an oil-fired boiler supplies heat for the ship. Two 750-kw diesel generators act as emergency standby sources for electricity and propulsion power.

Westinghouse Electric Corporation now offers an advanced PWR to produce 360 mwe from 1140 mwt in the reactor. The reactor would serve five loops to produce 680-psia saturated steam. With 330-mwe net capacity, 14% capital charges, 80% plant factor and 15,000 mwd per ton U burnup they predict an energy cost of 8.4 mills per kwhr (excluding taxes and interest during construction, land, improvements, escalation and administrative overhead). This compares with an average national cost of about 8.1 mills per kwhr for conventional-fuel-fired plants. This plant could be built and running by 1965.

Boiling water reactors. BORAX series of reactors designed by Argonne National Laboratory and installed and tested at NRTS gave birth to the development of this reactor type. Early conservatism in reactor design was highlighted by the Experimental Boiling Water Reactor (EBWR) at Argonne National Lab.

EBWR was originally designed to develop 20 mwt and five mwe. But actual operation showed the reactor could develop about 62 mwt with perfect operating stability. Larger natural water circulation through the core and more stable operation than anticipated with increased voids accounted for the improved capacity.

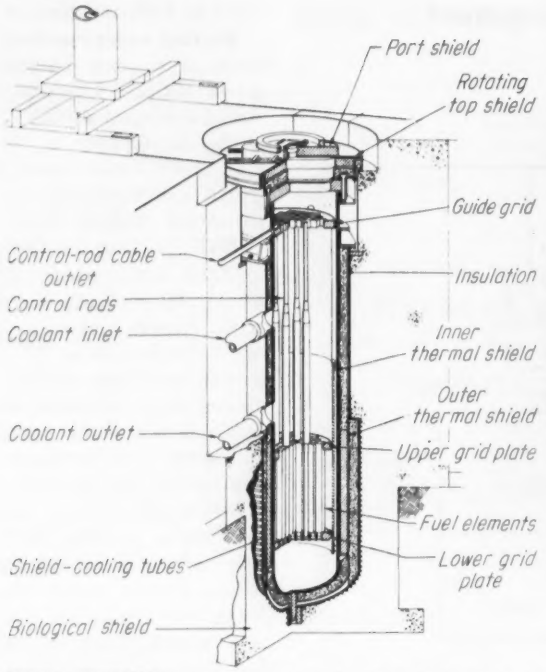
EBWR is being fitted with a modified core to generate 100 mwt. New heat exchangers for the laboratory's central heating system and cooling towers will absorb the increased energy output. Electrical capacity of five mwe won't be raised.

GE's Vallecitos Boiling-Water Reactor supplies data for engineering fuel elements and core layout for the dual-cycle boiling-water reactor of the Dresden Nuclear Power Station of Commonwealth Edison Company. The VBWR develops about five mwe delivered into the Pacific Gas and Electric Co system in California. Tests have shown reactor power output could be raised substantially with good operating stability.

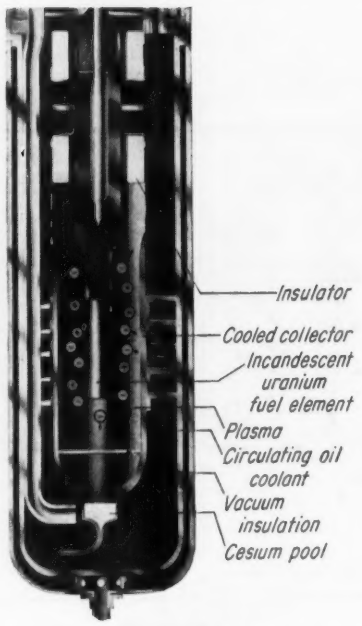
Technical objectives set by GE in its BWR program, if realized only partly, will make 6.0- to 7.0-mills-per-kwhr power production possible by 1965. These aims include: (1) doubling core's specific power (2) engineering more compact reactor and auxiliary systems (3) raising plant capacity to the 400- to 500-mwe range (4) using modern steam conditions and achieving thermal efficiencies of 28 to 35% (5) halving fuel fabrication costs and raising burnup to 15,000 mwd per ton U.

GE proposes to attain some, if not all, of these aims by parallel development of reactors with: (1) natural water circulation (2) forced circulation in compact cores (3) forced circulation in high power density cores (4) nuclear superheating. Ultimate designs may include these features.

Pathfinder's boiling-water reactor being built by Allis-Chalmers Manu-



PIQUA MUNICIPAL reactor uses terphenyl as both moderator and coolant. Low pressure reduces cost of the reactor vessel



PLASMA THERMOCOUPLE using cesium vapor and fissioning U makes 3-v electricity

facturing Co for Northern State Power Co and ten other utilities will use forced circulation and nuclear superheating. The 203-mwt reactor will produce 62-mwe net. Steam to turbine will be supplied at 600 psig and 825 F. Core fuel charge will last about one year; superheater fuel will be replaced once a year and one-third the boiler fuel-core section will be changed three times a year.

Containment. About 10 to 20% of an atomic power plant's cost arises from the present AEC requirement for a safety containment shell completely encasing reactor and radioactive systems of the plant. Despite the improbability of an accident releasing radioactive gases, AEC leans in the direction of extreme caution to guard against a possibly nasty situation.

Much study and effort has gone into designing economy containment shells varying from spheres to vertical and horizontal cylinders and concrete bunkers. Shells are designed to hold gases and vapors released in the worst possible accident at the highest probable pressure they would develop. In addition to holding the gases the shell must withstand puncturing by any solid fragment shot from bursting equipment or piping.

Cost creates a strong incentive to eliminate the shell. Two efforts have been reported in this direction. Pacific Gas and Electric Co and GE have studied and tested a method of pressure suppression. The reactor vessel would be housed in a low-pressure vessel inside a concrete structure. Pipes connect the l-p vessel to a large and inexpensive water tank underground. Any radioactive steam released from the reactor in an accident would be condensed and held in the water.

Sargent & Lundy are running a series of tests with a simulated reactor tank submerged in various depths of water in a larger tank. Hot water and steam released by a ruptured reactor vessel would be cooled and condensed in the water without any pressure buildup. Results from both of these methods encourage expectation of an eventual reduction in plant containment costs.

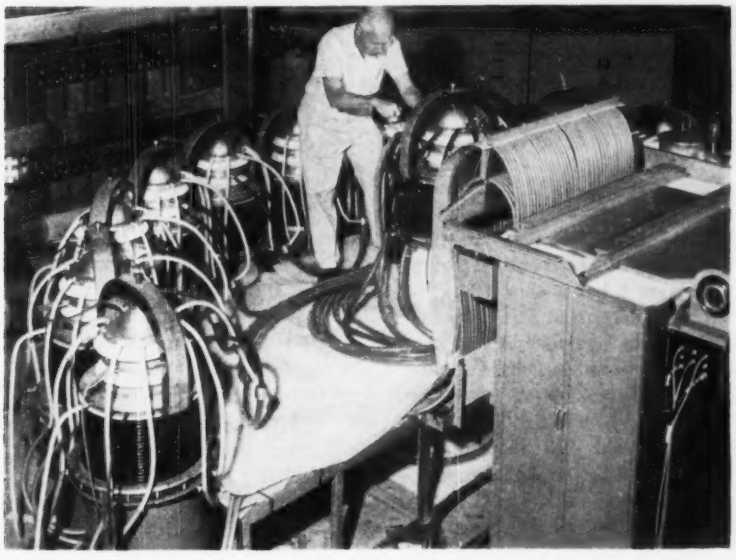
Power generation in distant future begins to take shape

As our scientists break through succeeding walls of ignorance we get to know the nature of matter and energy. With better understanding comes the opportunity for exploitation. At this stage of our progress new discoveries suggest some radical departures in energy-conversion processes that we can use in the future.

Increasing uses of electric energy have set the stage for strong urges to seek simpler ways of generating it. Heat created by chemical combustion or nuclear fission is still the prime form of energy. Thermocouples have long suggested an uncomplicated way of converting heat to electricity, but at discouragingly low thermal efficiency.

With the development of semiconductors and plasmas the simple process of changing heat to electricity at

COLUMBUS-2 represents one step in trying to develop fusion reactor using a fast linear pinch. This Sherwood device runs at 100 kv and discharges currents of 10^6 amps

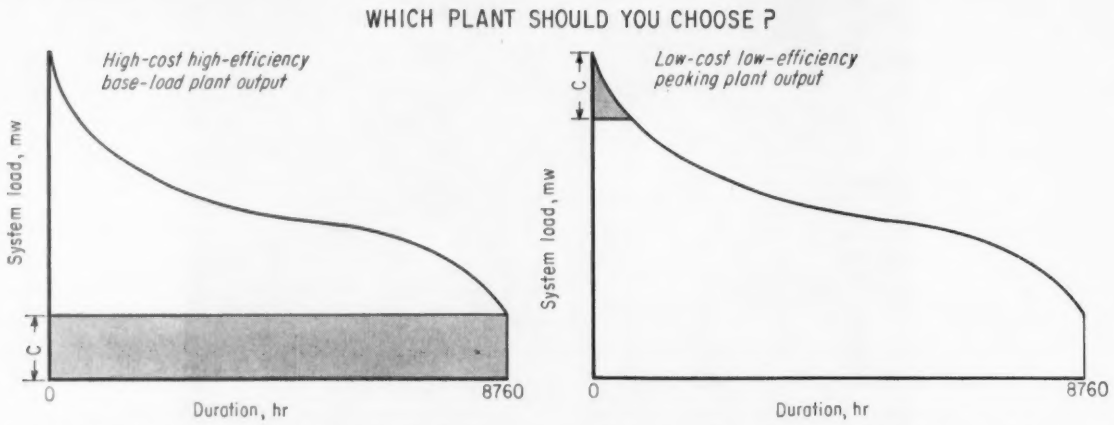


SCYLLA is another try at producing a dense high-temperature plasma by shock heating followed by a fast magnetic compression; temperatures may be about 20-million F

acceptable efficiency begins to look promising. For the present, however, we'll still use boilers and turbines because of better overall economy. Only the rash would dare to predict *when* our proven methods will be superseded by better ones, but better methods are a future certainty.

Discovery of the fusion process has led to intense researching in magnetohydrodynamics (MHD) — a basic field of study for astrophysicists. MHD concerns the behavior of electrically conducting fluids (plasmas) in a magnetic field. These actions take place in the stars and our sun. We are attempting to adapt these cosmic-scale actions to puny earthbound machines; success will let us develop heat and electricity from fusion reactions of plentiful deuterium.

An intermediate step in this long-term development seeks to use high-temperature plasmas to generate electricity directly at the expense of temperature drop. The cooled plasma would then pass through a boiler-turbine cycle to generate electricity conventionally. POWER will carry an article by Philip Sporn, president of American Electric Power Company, Inc, describing the project in a forthcoming issue.



NEW HIGH-EFFICIENCY STEAM PLANTS usually take over base of system load and generate maximum kwhr. Peaking plants run only at time of system peak, generate few kwhr; this pays off if installed cost of new peaking plant is low enough

Growing high-efficiency systems should consider buying low-cost peaking plants

A system needs more capacity when the peak load exceeds the existing installed protected capacity. With continuing improvement of generating equipment in the past few years it has generally paid to add the new capacity in the form of high-efficiency boilers and turbines to gain economy in fuel consumption and lower the overall system heat rate.

But today some systems have a major percentage of their capacity in high-efficiency plants. Adding another high-efficiency unit has little effect on improving overall system heat-rate performance.

A high-efficiency plant costs more than a low-efficiency plant because of the extra energy-conserving equipment used. By buying a low-cost low-efficiency plant and running it just at the time of the peak it may be possible to generate the total system output at a lower overall cost when considering all annual capital charges and operating costs. The basic principles are outlined in "The gas turbine as a stationary prime mover" by Rowley and Skrotzki, *Transactions of the ASME*, January, 1949, pp 37-39.

Peaking plants have been suggested for many years, but their first notable application will be by the Philadelphia Electric Company. This utility has installed an *Electro-Motive* diesel unit at its Plymouth Meeting Substation. This semiportable unit will develop six mw when superchargers are installed. The plant runs automatically and picks up full load in 83 seconds from a cold start.

PEC is now installing a 20.5-mw General Electric gas turbine and a 22-mw Westinghouse Electric gas turbine. These will be single-shaft simple-cycle units burning natural gas or distillate fuel.

These units will make a double-barreled saving; they'll be placed along transmission lines in suburban areas. This will help reduce transmission-system load and capacity as well as add to overall system capacity. The units can also act as emergency standby energy sources for limited distribution areas in event of transmission-line outage.

Any breakthrough in lowering costs on high-efficiency plants would again put the low-cost peaking plant on the shelf. But such a likelihood seems rather remote. In any event, remember the basic principle that usually only high-efficiency electric systems can justify using low-cost low-efficiency peaking plants to achieve maximum system economy.

Pumped-storage hydro plant is another form of peaking plant gradually being adopted in the U.S.A. This type has been used overseas for some time. Wherever two different pond levels near each other can be found this type of plant might pay off. The hydro plant uses pump-turbine units. During low system loads the generators act as motors and drive the units as pumps to lift water from the low to the high pond—thermal or other hydro plants supply the energy through transmission systems.

During system peaks water from the high pond flows through the pump-turbines driving them as turbines and generating power to help carry the system peak load. Overall efficiency of the pumped-storage system of peak-load generation ranges about 60 to 70% taking account of evaporation losses.

Power
OCTOBER
1959

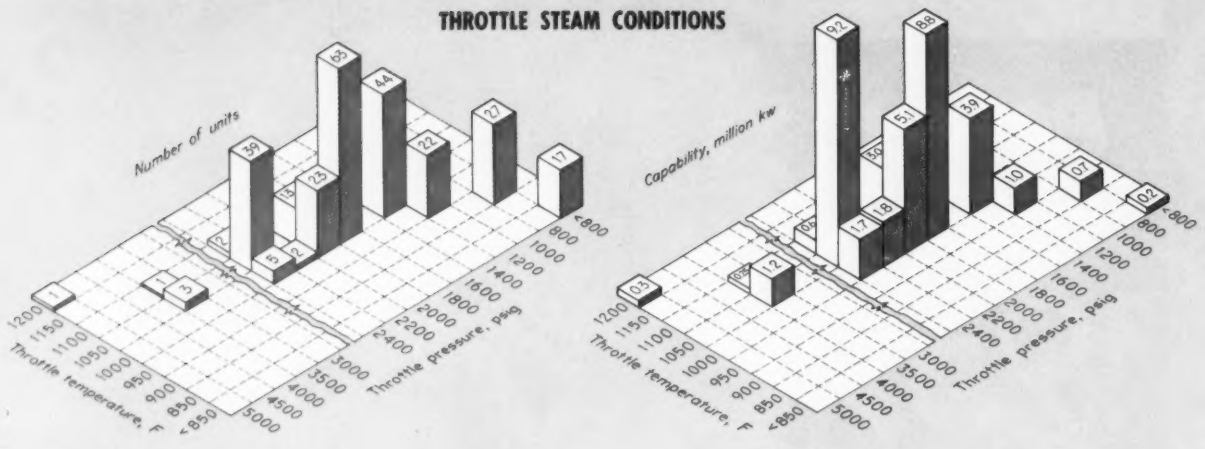
Central Station Design Survey

Tabulations on the following pages include conventionally fueled and nuclear plants. Design data on conventional steam plants is the most complete that can be had for units planned, under construction and starting operation. The number of design features reported per plant is, as in last year's survey, double that reported in earlier years.

However, because of the way we must compile facts, this survey of conventional steam plants does not include *all* current programs, nor does it consist *only* of current construction. Here's why:

Working from lists of planned installations, POWER editors sent questionnaires to individual companies asking for project details. Data may appear in the tables well before construction starts; or if engineering is delayed, may appear long after a project was announced.

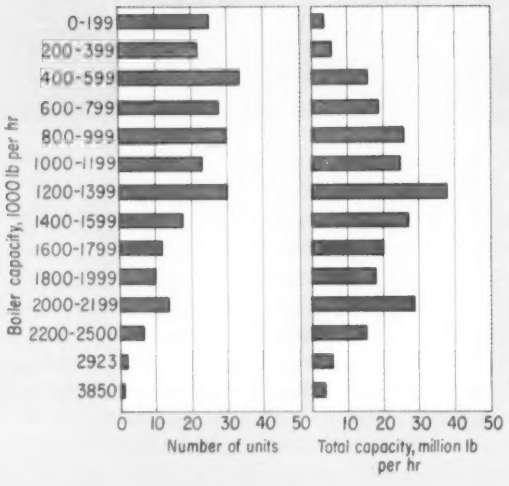
Being representative of design and construction in late 1958 and early 1959, the following tables give useful information on general trends. But you can see that by the very nature of things these tabulations can't be complete. Consider them as extensive samples. Don't use them to get total values or where incompleteness would distort results.



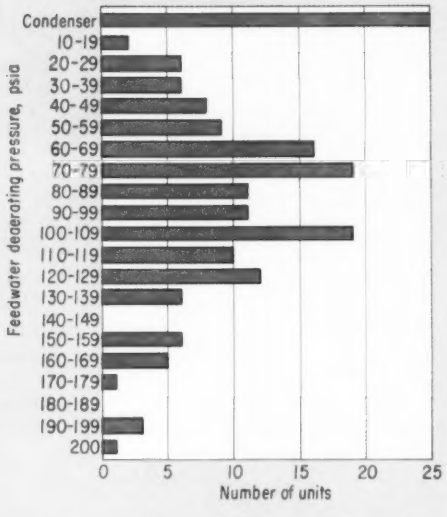
THROTTLE STEAM CONDITIONS of 2400 psig and higher gain in favor for new and projected units in 1959 and later

SIXTY PERCENT of new turbine capability starting in 1959 or later will use throttle steam at 2000 psig, 1000 F and higher

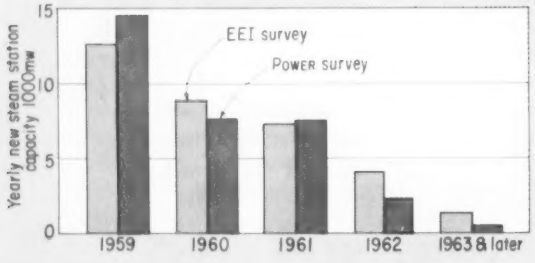
Trends in CENTRAL STATIONS



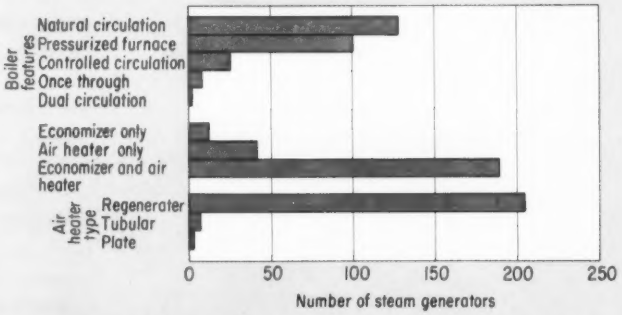
STEAM-GENERATOR RATINGS for 1959 and later maintain same levels as 1958 for maximum sizes, most popular capacities



FEEDWATER DEAERATING pressures concentrate in middle ranges (46% of units at 70-130 psia); about 14% use condenser only

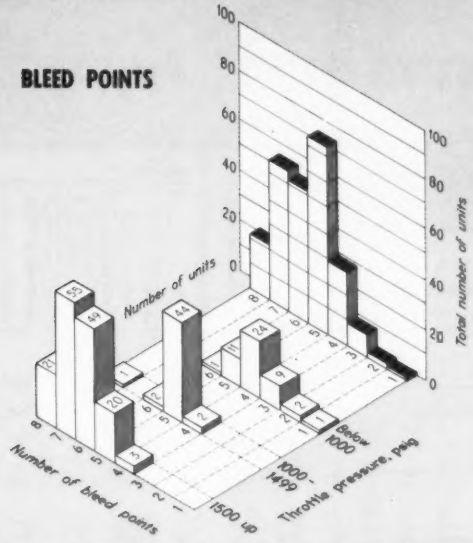


POWER SURVEYS in this and previous reports cover about 90% of 34.6-million-kw steam capability scheduled for 1959-1963



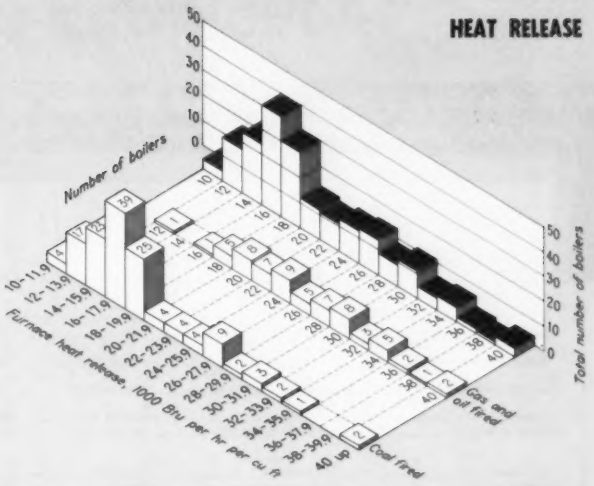
STEAM-GENERATOR FEATURES still show growing use of all heat-recovery units, higher percentage of pressurized furnaces

BLEED POINTS

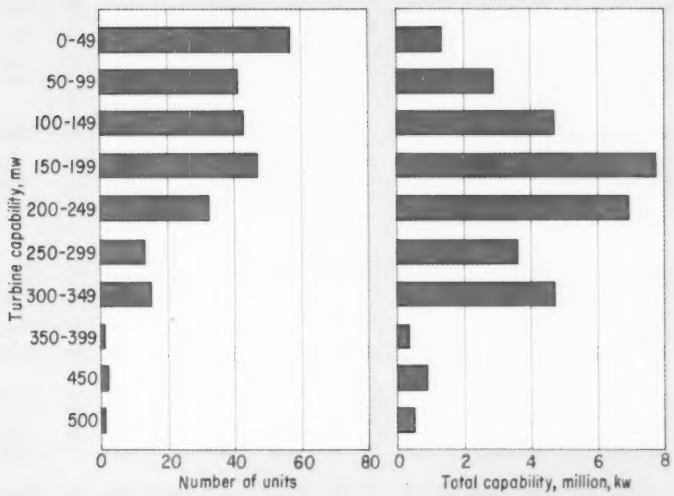


FIVE BLEED POINTS continue to predominate for all turbines; seven points find most frequent favor for the high-pressure units

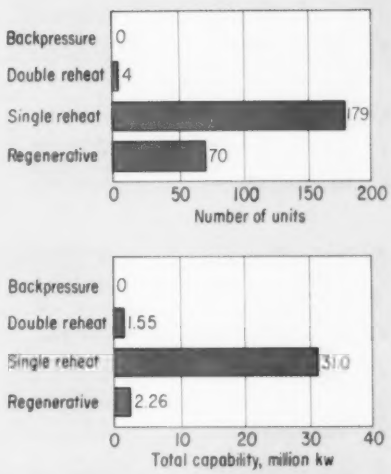
HEAT RELEASE



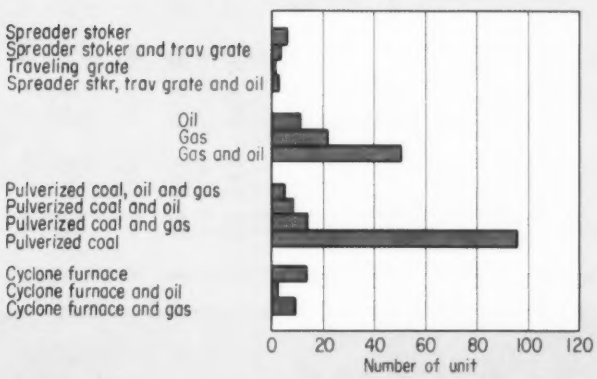
FURNACE HEAT RELEASE rate between 10-20,000 covers 80% of coal-fired units; over 20,000 covers 90% of oil, gas fuels



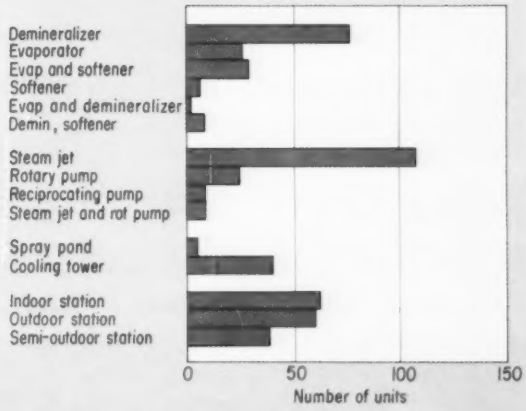
TURBINE CAPABILITIES and number of units show distribution similar to 1958 survey while average capacity has grown from 127 to 134 for all types of installations



REHEAT TURBINES have same percentage as last year; average size is 178 mw



FIRING EQUIPMENT shows about same proportion of coal-fired furnaces as in 1958 survey; coal still predominates



STATION FEATURES show indoor plants now only 38% of total; outdoor units have risen to 37%; semioutdoor stay about 25%

TABLE 1

1959 design survey of typical

Note that each listing covers four pages. The project number helps you keep track of a specific installation after you turn the facing page

Project Number	Company	Location	Plant Name	Consulting Engineers	Unit No., new unit	First operation, new unit	Throttle pressure, psig	Steam temperature, F		Number	Capacity each, 1000 lb per hr
								Throttle	Reheat		
1	Cleveland Electric Illuminating Co	Avon Lake, Ohio	Avon	Self	8	10-59	3500	1100	1050	1[1,2]	1715
2	Virginia Electric & Power Co	Dumfries, Va	Possum Point	Stone & Webster Engrg Corp	4	4-62	2520	1000	1000	1[3]	1620
3	Baltimore Gas & Electric Co	Baltimore County, Md	Charles P. Crane	Self	1	5-61	2400	1050	1000	1[2,4]	1357
4	The Dayton Power & Light Co	Dayton, Ohio	Frank M. Tait	Gilbert Associates, Inc	5	6-59	2400	1050	1000	1	940
5	The Detroit Edison Co	East China Twp, Mich	St. Clair	None	6[7]	4-61	2400	1050	1000	1[4]	2100
6	Duke Power Co	Belmont, N. C.	Allen Plant		5	7-61	2400	1050	1000	1	1800
7	Ohio Edison Co	Stratton, Ohio	Stratton	Commonwealth Associates, Inc	1	5-59	2400	1050	1000	1	1250
8	Ohio Edison Co	Stratton, Ohio	Stratton	Commonwealth Associates, Inc	2	5-60	2400	1050	1000	1	1250
9	Ohio Edison Co	Stratton, Ohio	Stratton	Commonwealth Associates, Inc	3[7]	5-61	2400	1050	1000	1	1250
10	Ohio Edison Co	Stratton, Ohio	Stratton	Commonwealth Associates, Inc	4[7]	5-62	2400	1050	1000	1	1250
11	Pensylvania Power & Light Co	York Haven, Pa	Brunner Island	Ebasco Services, Inc	1[7]	2-61	2400	1000	1000	1[3]	2100
12	Public Service Electric & Gas Co	Hamilton Twp, N J	Mercer		1[7]	1960	2400	1100	1050	1[1,3]	2060
13	Public Service Electric & Gas Co	Hamilton Twp, N J	Mercer		2[7]	1961	2400	1100	1050	1[1,3]	2060
14	South Carolina Electric & Gas Co			Gilbert Associates, Inc	1	1962	2400	1050	1000	1[4]	910
15	Wisconsin Electric Power Co	Milwaukee County, Wis	Oak Creek	Ebasco Services, Inc	6	12-61	2400	1050	1000	1	1780
16	United Illuminating Co	Bridgeport, Conn	Bridgeport Harbor	Jackson & Moreland	2	8-61	2115	1000	1000	1[4]	1150
17	Arkansas Power & Light Co	Helena, Arkansas	Helena	Ebasco Services, Inc	1	3-61	2000	1000	1000	1[3]	2300
18	Commonwealth Edison Co	Chicago, Illinois	Crawford	Sargent & Lundy	8	6-61	2000	1050	1000	1	2200
19	Florida Power & Light Co	Port Everglades, Fla	Port Everglades	Bechtel Corp	2	4-61	2000	1000	1000	1[3]	1600
20	Houston Lighting & Power Co	Smithers Lake, Tex	W A Parish	Ebasco Services, Inc	3	1-61	2000	1000	1000	1[3]	1920
21	Houston Lighting & Power Co	Casey, Texas	North Houston	Ebasco Services, Inc	2[7]	1-60	2000	1000	1000	1[3]	1550
22	Houston Lighting & Power Co	Strang, Texas	Sam Bertron	Ebasco Services, Inc	4[7]	1-60	2000	1000	1000	1[3]	1550
23	Jersey Central Power & Light Co	Sayreville, N J	Sayreville	Burns & Roe, Inc	5	10-58	2000	1050	1000	1	990
24	Louisiana Power & Light Co	La Place, La	Little Gypsy	Ebasco Services, Inc	1[15]	1-61	2000	1000	1000	1[3]	1550
25	Texas Electric Service Co	Graham, Texas	Graham	Ebasco Services, Inc	1[7]	12-60	2000	1000	1000	1[3]	1550
26	California Electric Power Co	Yuma, Arizona	Yuma Axis	Bechtel Corp	1[7]	3-59	1850	1000	1000	1[3]	575
27	Kansas City Power & Light Co	LaDue, Mo	Montrose	Ebasco Services, Inc	3	1963	1815	1000	1000	1[3]	1260
28	Arizona Public Service Co	Tempe, Arizona	Ocatillo	Ebasco Services, Inc	1[15]	2-60	1800	1000	1000	1[3]	800
29	Arizona Public Service Co	Tempe, Arizona	Ocatillo	Ebasco Services, Inc	2[15]	4-60	1800	1000	1000	1[3]	800
30	Arizona Public Service Co	Farmington, N M	Four Corners	Ebasco Services, Inc	1	1-62	1800	1000	1000	13	1270
31	Arizona Public Service Co	Farmington, N M	Four Corners	Ebasco Services, Inc	2	3-62	1800	1000	1000	1[3]	1270
32	Carolina Power & Light Co	Darlington County, S C	Darlington County	Ebasco Services, Inc	1	5-60	1800	1000	1000	1[3]	1260
33	Dallas Power & Light Co	Dallas, Texas	North Lake	Ebasco Services, Inc	1[7]	1-60	1800	1000	1000	1[3]	1260
34	Dallas Power & Light Co	Dallas, Texas	North Lake	Ebasco Services, Inc	2[15]	1-62	1800	1000	1000	1[3]	1260
35	Florida Power Corp	St. Petersburg, Fla	Paul L. Barlow	Black & Veatch	2[7]	7-61	1800	1000	1000	1	900
36	Gulf Power Co	Pensacola, Fla	Crist	Southern Services, Inc	5	4-61	1800	1000	1000	1	582
37	Gulf States Utilities Co	Orange County, Texas	Sabine	Stone & Webster Engrg Corp	1	3-62	1800	1000	1000	1[3]	1584
38	Gulf States Utilities Co	Orange County, Texas	Sabine	Stone & Webster Engrg Corp	2	3-62	1800	1000	1000	1[3]	1584
39	The Hartford Electric Light Co	Middletown, Conn	Middletown	Stone & Webster Engrg Corp	2	10-58	1800	1000	1000	1	800
40	Iowa-Illinois Gas & Electric Co	Davenport, Iowa	Riverside	Sargent & Lundy Engr	5	6-61	1800	1000	1000	1	860
41	Kansas Gas & Electric Co	Wichita, Kan	Gordan Evans	Ebasco Services, Inc	1[15]	4-61	1800	1000	1000	1[3]	1020
42	The Kansas Power & Light Co	Lawrence, Kan	Lawrence	Black & Veatch	4[7]	2-60	1800	1005	1005	1[3]	842
43	Kansas City Power & Light Co	Clinton, Mo	Montrose	Ebasco Services, Inc	2	3-60	1800	1000	1000	1[3]	1260
44	Kansas City Power & Light Co	Clinton, Mo	Montrose	Ebasco Services, Inc	3	.....	1800	1000	1000	1[3]	1260
45	Long Island Lighting Co	Island Park, N Y	Edward F. Barrett		2	1962	1800	1000	1000	1[4]	1150
46	Long Island Lighting Co	Port Jefferson, N Y	Port Jefferson	Ebasco Services, Inc	4[7]	10-60	1800	1000	1000	1[4]	2150
47	Montaup Electric Co	Somerset, Mass	Somerset	Stone & Webster Engrg Corp	6	7-59	1800	1000	1000	1	800
48	Public Service Co of Colorado	Denver, Col	Cherokee	Ebasco Services, Inc	3	4-62	1800	1000	1000	1[4]	1140
49	Public Service Co of Indiana, Inc	New Albany, Ind	New Albany	Sargent & Lundy	1[7]	5-59	1800	1000	1000	1	1000
50	Public Service Co of Indiana, Inc	New Albany, Ind	New Albany	Sargent & Lundy	4[7]	1-61	1800	1000	1000	1	1000
51	Public Service Co of New Hampshire	Bow, New Hampshire	Merrimack	Jackson & Moreland, Inc	1[15]	9-60	1800	1000	1000	1[4]	815

SYMBOLS USED ABOVE

By - Gas bypass
ByD - Bypass damper
D - Damper
DB - Dry bottom
FG - Flue gas recirculation
Hy - Hydraulic coupling
M - Motor
Ma - Magnetic coupling
Mp - Two motors per fan
N - None
No - Number of burners
Pd - Pressurized
Pl - Plate
Pre - Precondensing
Re - Regenerative
S - Speed control
ST - Slag tap
T - Turbine
TB - Tilting burner
TF - Twin furnace
Tu - Tubular
V - Vane control
WS - Water spray
1 - Twin furnace
2 - Once through boiler
3 - Outdoor unit
4 - Semioutdoor unit
5 - By rate of fuel firing
6 - Cyclones
7 - Revised data, previously listed 12-57
8 - Differential firing
9 - Quadruple furnace
10 - Secondary reheat control
11 - Gas biasing
12 - 1000 lb per hr
13 - 1000 Btu per sq ft per hr
14 - Plus overriding water spray
15 - Revised data, previously listed 10-58
16 - Louvre
17 - Basket type bottom

MANUFACTURERS

AB - American Blower Corp
AC - Allis-Chalmers Mfg Co
AP - Alco Products, Inc

new central-station installations

		BOILERS								FURNACE					F-D FANS							I-D FANS							
		Surface, 1000 sq ft																											
	Manufacturer	Boiler & Waterwalls	Superheater	Reheater	Economizer	Air heater	Superheat control	Reheat control	Air heater type	Pressure, in. water	Volume 1000 cu ft	Heat release, 1000 Btu per cu ft per hr	No. of burners	Bottom	No. per boiler	Capacity each, 1000 cfm	Manufacturer	Air flow control	Drive	Drive hp	Drive manufacturer	No. per boiler	Capacity each, 1000 cfm	Manufacturer	Gas-flow control	Drive	Drive hp	Drive manufacturer	
	CE	14.8	32.2	33.0	92.6	584.4	WS	WS,TB	Re	-1.0	318	6.6	32	DB	2	355	SW	V	M	2000/1250	EL	2	460	SW	V	M	3000/2000	EL	1
	CE	27	141	26	65	213	WS,TB	WS,TB	Re	-0.15	124	17.5	32	.....	2	270	.....	D,V	M	.....	...	2	370	.....	D	M	.....	.....	2
	BW	25.2	54.5	13.1	30.0	334	.....[5]	FG	Re	14.3	63.9	27.3	4[6]	ST,Pd	2	217	AB	V	M	2500	WE	N	.....	.....	.....	.....	.....	.....	3
	CE	16.1	63.5	33.9	25.1	153	WS	TB	Re	.....	.....	16	16	DB	2	185	AB	V	M	600	AC	2	275	SW	D	M	900	AC	4
	CE	36.8	181	27.5	90.2	577	WS,TB	WS,TB	Re	.....	204	14.5	64	DB	2	395	AB	V	M	1250	GE	2	555	SW	D	M	3000	GE	5
	CE	35.9	170	31.5	37.6	394	TF,TB	TB	Re	0.15	165	14.8	32	DB	2	355	AB	V	M	900	GE	2	495	AB	D	M	2000	GE	6
	FW	30.4	33.6	77.8	52.6	280	Pre	ByD	Re	-.10	94.6	18.0	15	DB	2	225	SW	V	M	600	EL	2	326	SW	V	M	900	EL	7
	FW	30.4	33.6	77.8	52.6	280	Pre	ByD	Re	-.10	94.6	18.0	15	DB	2	225	SW	V	M	600	EL	2	326	SW	V	M	900	EL	8
	FW	30.4	33.6	77.8	52.6	280	Pre	ByD	Re	-.10	94.6	18.0	15	DB	2	225	SW	V	M	600	EL	2	326	SW	V	M	1000	EL	9
	FW	30.4	33.6	77.8	52.6	280	Pre	ByD	Re	-.10	94.6	18.0	15	DB	2	225	SW	V	M	600	EL	2	326	SW	V	M	1000	EL	10
	CE	35.6	186.5	56.1	61.0	349	WS	WS,TB	Re	-0.15	221.2	13.0	40	DB	2	380	SW	D,V	M	900	WE	2	565	SW	D,V	M	2250	WE	11
	FW	57.9	96.8	88.7	95.0	714	Pre	.....[8]	Re	15	193	13.8	24	ST,Pd	2	325	AB	Hy	M	3000	GE	N	.....	.....	.....	.....	.....	.....	12
	FW	57.9	96.8	88.7	95.0	714	Pre	.....[8]	Re	15	193	13.8	24	ST,Pd	2	325	AB	Hy	M	3000	GE	N	.....	.....	.....	.....	.....	.....	13
	CE	19.06	71	13.7	39	88	WS	TB	Re	0.15	52.5	21.2	16	DB	2	168	....	Ma	M	450	....	2	232	.....	Ma	M	900	.....	14
	FW	76.4	40.7	8	376	795	No[9]	.....[10]	Re	-0.1	173	13.1	16	DB	2	316	....	S	M	....	....	2	440	.....	S	M	.....	.....	15
	BW	33.7	36.7	10.9	9.8	....	WS,FG	WS,FG	Re	11.9	49.9	30.6	5[6]	ST	2	214	BF	V	M	2500	WE	N	.....	.....	.....	.....	.....	.....	16
	BW	....	....	....	....	....	WS,FG[11]	WS,FG[11]	Re	9.8	16.6	.....	8[6]	Pd	3	272	IR	D,V	M	4000	GE	N	.....[12]	.....	...	...	.....	.....	17
	CE	37.8	202	36.3	82.0	509	WS,No,TB	WS,TB	Re	.....	254	11.4	32	DB	2	1439[12]	GF	V	M	1250	EL	2	1847[12]	SW	Hy	M	3000	EL	18
	CE	17.4	82.4	26.2	49.2	205	WS,FG	WS,FG	Re	.....	124.8	98[13]	16	DB	2	320	AB	D,V	M	900	GE	2	458	AB	D,Hy	M	1750	GE	19
	FW	55.2	28.3	75.5	73.7	469	Pre	By[14]	Re	10	110	25.2	24	DB,Pd	2	280	SW	V	M	1500	AC	N	.....	.....	.....	.....	.....	.....	20
	CE	29.1	101.3	18.9	26.9	345	WS,TB	WS,TB	Re	10.0	95.0	21.6	24	Pd	2	255	AB	V	M	1250	EL	N	.....	.....	.....	.....	.....	.....	21
	CE	29wl	101.3	18.9	26.9	345	WS,TB	WS,TB	Re	10.0	95.0	21.6	24	Pd	2	255	AB	V	M	1250	EL	N	.....	.....	.....	.....	.....	.....	22
	BW	21.2	44.5	29.0	None	257	WS,By,FG FG	By,FG	Tu	20	27.9	42.7	4[6]	ST,Pd	2	675	SW	D,V	M	2000	WE	N	.....	.....	.....	.....	.....	.....	23
	RS	84.5	93.0	72.0	24.8	324	WS	WS	Re	11.5	104.3	20.7	18	Pd	2	225	AB	V	Mp	1250	GE	N	.....	.....	.....	.....	.....	.....	24
	FW	40.6	21.4	46.2	64.1	296	Pre	D	Re	14	90.0	24.4	18	Pd	2	224	AB	Hy	Mp	1850	GE	N	.....	.....	.....	.....	.....	.....	25
	CE	14.1	36	10	7.9	110	WS	WS,TB	Re	16.5	31.5	126.5[13]	12	Pd	1	210	SW	V	M	900	WE	N	.....	.....	.....	.....	.....	.....	26
	CE	27.2	84.4	18.0	51.6	116	WS,TB	WS,TB	Re	0	102	16.9	40	DB	2	208	AB	V	M	600	WE	2	337	AB	D	M	1500	WE	27
	CE	20.0	38.3	8.3	15.8	.....	WS,TB	WS,TB	Re	9.65	58.0	22.1	32	Pd	2	122	SW	D,V	M	600	GE	N	.....	.....	.....	.....	.....	.....	28
	CE	20.0	38.3	8.3	15.8	.....	WS,TB	WS,TB	Re	9.65	58.0	22.1	32	Pd	2	122	SW	D,V	M	600	GE	N	.....	.....	.....	.....	.....	.....	29
	RS	19.7	42.3	61.5	24.4	272	WS,No	D	Re	-0.10	95.4	17.9	18	DB	2	217	GF	V	M	600	....	2	325	GF	D	M	1250	.....	30
	RS	19.7	42.3	61.5	24.4	272	WS,No	D	Re	-0.10	95.4	17.9	18	DB	2	217	GF	D	M	600	....	2	325	GF	D	M	1250	.....	31
	CE	27.2	108.8	20.19	34.3	233	WS	WS,TB	Re	-0.15	102.4	16.5	40	DB	2	222	SW	D	M	700	GE	2	318	SW	D	M	1500	GE	32
	RS	40.3	49.4	41.8	19.2	169	WS,By	WS,D	Re	8.5	63.4	26.7	16	Pd	2	166	AB	D,V	M	1000	GE	N	.....	.....	.....	.....	.....	.....	33
	RS	40.3	49.4	41.8	19.2	169	WS,By	WS,D	Re	8.5	63.4	26.7	16	Pd	2	166	AB	D,V	M	1000	GE	N	.....	.....	.....	.....	.....	.....	34
	CE	15.1	60.1	16.5	31.3	163	WS,FG, TB	TB	Re	9.1	76.5	....	24	DB	2	168	AB	Hy	M	600	EM	2	256	AB	D	M	900	EM	35
	CE	14.0	48.8	7.8	12.2	200	WS	WS,TB	Re	-0.5	42.4	18.2	16	DB	1	205	SW	V	M	450	GE	1	330	SW	D,Hy	M	1500	GE	36
	CE	22.7	107	21.4	27.5	242	WS	TB	Re	8.2	83	36.3	32	Pd	2	262	SW	V	M	1600	WE	N	.....	.....	.....	.....	.....	.....	37
	CE	22.7	107	21.4	27.5	242	WS	TB	Re	8.2	83	36.3	32	Pd	2	262	SW	V	M	1600	WE	N	.....	.....	.....	.....	.....	.....	38
	RS	41.2	46.7	30.2	12.6	206	WS	WS	Re	-0.1	65.5	16.2	12	DB	2	145	AB	D,V	M	400	GE	2	206	AB	D,Hy	M	700	GE	39
	CE	17.5	69.0	14.1	12.5	225	WS,TB	WS,TB	Re	.....	87	15	16	DB	2	170	GF	V	M	500	GE	2	255	GF	Hy	M	1000	GE	40
	RS	37.7	59.2	51.6	15.3	169	WS,By	WS,By	Re	8.0	54.0	27.0	12	DB,Pd	2	180	SW	D,V	M	800	WE	N	.....	.....	.....	.....	.....	.....	41
	CE	15.9	58.7	15.6	25.8	143	WS,TB	WS,TB	Re	.....	83.0	.....	4	DB	2	180	PD	V	M	700	GE	2	221	PD	S,D	M	900	GE	42
	CE	27.2	84.4	18.0	51.6	233	TB	TB	Re	0.15	102	17	40	DB	2	181	AB	V	M	600	GE	2	293	AB	.....[16]	M	1500	GE	43
	CE	27.2	84.4	18.0	51.6	233	TB	TB	Re	0.15	102	17	40	DB	2	181	AB	V	M	600	GE	2	293	AB	.....[16]	M	1500	GE	44
	CE	51.4	78.1	13.0	26.9	115	WS,TB	WS	Re	-0.15	113.3	13.8	20	DB	2	191	SW	V	M	600	GE	2	297	SW	D	M	1750	GE	45
	CE	51.4	80.6	13.1	28.5	114	WS,TB	WS,TB	Re	-0.15	113.3	13.8	20	DB	2	210	SW	V	M	600	GE	2	327	SW	D	M	1750	GE	46
	CE	13.7	59.9	10.6	21.5	56.1	WS,TB	WS,TB	Re	.....	67.7	19.4	12	.....[17]	2	132	AB	D	M	450	GE	2	211	AB	Hy	M	900	GE	47
	BW	20.4	90.9	23.5	14.4	229	WS	WS,FG	Re	0.10	91.3	16.3	16	DB	2	208	SW	V	M	500	WE	2	300	SW	V	M	1200	WE	48
	RS	26.0	54.7	60.4	16.6	390	WS,By	By	Re	-0.5	96	14.1	18	DB	2	168	BF	V	M	600	GE	2	218	BF	Hy	M	1250	GE	49
	RS	26.0	54.7	60.4	16.6	390	WS,By	By	Re	-0.5	96	14.1	18	DB	2	168	BF	V	M	600	GE	2	218	BF	Hy	M	1250	GE	50
	BW	14.4	42.7	15.0	25.0	173	WS	WS,FG	Re	12.6	37.1	28.8	3[6]	ST,Pd	2	157	BF	V	M	2000	WE	N	.....	.....	.....	.....	.....	.....	51

APC - Apra Precipitation Corp
ASH - Allen-Sherman-Hoff Co
AT - Aerotec Corp
AWS - American Water Softener Co
BF - Buffalo Forge Co
BJ - Byron-Jackson Pumps, Inc
BM - Bailey Meter Co
BU - Buell Engineering Co, Inc
BW - Babcock & Wilcox Co
CB - Chain Belt Co

CE - Combustion Engineering Inc
CFB - C F Braun Co
CHW - C H Wheeler Mfg Co
CIW - Clyde Iron Works
COC - Cochrane Corp
CON - Continental Gin Co
CSM - Colby Steel & Mfg Co, Inc
CV - Copes-Vulcan Div, Blaw-Knox Co
DP - Diamond Power Specialty Corp
DS - Daystrom Systems Division

EL - Elliott Co
EM - Electric Machinery Mfg Co
FC - The Fosboro Corp
FE - Fairfield Engineering Co
FW - Foster Wheeler Corp
GE - General Electric Co
GF - Green Fuel Economizer Co, Inc
GR - Griscom-Russell Co
GW - Graver Water Conditioning Co

HCC - Hagan Chemicals & Controls, Inc
HL - Hall Laboratories
HP - Hoyt & Patterson, Inc
HR - Hewitt-Robins Inc
IN - Infilco, Inc
IR - Ingersoll-Rand Co
KC - Koppers Co, Inc
LA - L-A Water Softener Co
LB - Link-Belt Co

LN - Leeds & Northrup Co
MR - Milton Roy Co
McK - McKiernan Terry Co
PC - Pennsylvania Crusher
PB - Pral-Daniel Corp
PI - Proportioneers, Inc
PM - The Permutit Co, Div Pfaudler Permutit
PP - Pacific Pumps, Inc
RC - Research-Cottrell, Inc

Central-station installations TABLE 1 continued

	BOILER FEED PUMPS							FUELS								FIRING											
	Capacity each, gpm	Discharge pressure, psig	Manufacturer	Flow control	Drive	Drive hp	Drive manufacturer	Fuel type	Heating value, 1000 Btu per lb	Ash fusion temp, F	Fuel delivery method	Coal unloading system	Unloading system mfr	Handling system to storage	Handling system mfr	Coal firing equipment	Firing equipment mfr	No. pulverizers per boiler	Ash-handling system	Ash-handling system mfr	Soot blower type	Soot blowing medium	Soot blower mfr	Dust collector type	Dust collector mfr	Stack height, ft.
1	2285	11580[18]	WO	S,Hy	1M,2T	T-7710 M-8800	EL,GE	C	12.0	2250	RR,Tr	Dump	WL	Bu	LB	P	CE	8	Pn	ASH	Ret	Air	CV	El	BU	400
2	T-4075 M-965	T-2620 M-1683	IR	S	1M,1T	8650	GE,EL	C	13.1	2300	RR	CS	HR	Co	SA	P	CE	4	Pn,Hyd	.....	Sta,Ret	St	DP	El	.....	175
3	3035 1850[19]	3290 2650[19]	BJ	S R[19]	1T 1M	7000 3000	GE WE	C	13.5	2352	RR	Dump	HP	Co,Bu	SA	Cy	PC	4[20]	Hyd[21]	UC	Ret	Air	DP	El	KC	353
4	1165	3600	WO	R	2M	3500	AC,GE	C	12.0	2300	RR	Dump	LB	Co,Bu	FE	P	CE	4	Pn,Hyd	ASH	Ret	Air	DP	Me,Fl	BU	225[22]
5	2340	2950	BJ	Hy	2M	5000	GE	C	11.7	2200	Boat	Sb	N	Co,Bu,Sc	LB	P	CE	8	Hyd	UC,ASH	Ro,Ret	Air	CV	Me,El	RC	425
6	1350	2670	BJ	Hy	2M	4500	GE	C	13.3	2360	RR	CS,Dump	HP,HR	Co,Bu	SA	P	CE	8	Hyd	UC	Ro,Ret	St	DP	El	WP	250
7	1500	2883	PP	R	3M	3500	EL	C	11.0	2100	Ba,Tr	BuU	.....	Bu	LB	P	CE	5	Pn,Hyd	UC,ASH	Ret	Air	DP	El	BU	503
8	1500	2883	PP	R	3M	3500	EL	C	11.0	2100	Ba,Tr	BuU	.....	Bu	LB	P	CE	5	Pn,Hyd	UC,ASH	Ret	Air	DP	El	Bu	503
9	1500	2883	PP	R	3M	3500	EL	C	11.0	2100	Ba,Tr	BuU	.....	Bu	.....	P	CE	5	Pn,Hyd	UC,ASH	Ret	Air	DP	El	Bu	503
10	1500	2883	PP	R	3M	3500	EL	C	11.0	2100	Ba,Tr	BuU	.....	Bu	.....	P	CE	5	Pn,Hyd	UC,ASH	Ret	Air	DP	El	Bu	503
11	1900	3300	WO	R	3M	4000	WE	C	12.88	2250	RR	Dump	LB	Co,	HR	P	CE	5	Pn,Hyd	UC	Ro,Ret		CV	El	RC	450
12	2-2630 1-1315	2960	WO	R,Hy	1M,2T	2500	AC	C,G	13.0	2100	Ba,Pi	.....	HR	Co	HR	P	FW	3	Hyd	.....	Ret	Air	CV	Me,El	RC	325
13	2-2630 1-1315	2960	WO	R,Hy	1M,2T	2500	AC	C,G	13.0	2100	Ba,Pi	.....	HR	Co	HR	P	FW	3	Hyd	.....	Ret	Air	CV	Me,El	RC	325
14	1150	2800	.....	Ma	2M	2500	.....	C	13.5	2000	RR	CS	.....	Co,Bu	.....	P	CE	4	.....	.....	Ret	Air	.....	Me	.....	.....
15	2030 4060	3350 3070	AC	S	1M, 1T	4000 8180	.....	C	12.4	2100	Sn	Sb	.....	Bu,Uc	.....	P	FW	2	Pn	.....	Ret	St	.....	El	.....	450
16	1544	3100	PP	R	3M	3000	WE	C,O	13.0,18.4	2280	RR,Tr	CS	SA	Co,Bu	SA	Cy	BW	.....	Hyd	UC	Ro,Ret	St	DP	El	RC	250
17	2670	2520	PP	R	2M	5000	GE	G,O	974[26]	.....	Pi,RR	.....	.....	.....	.....	Cy	BW	.....	.....	.....	Ro,Ret	St	.....	.....	.....	450
18	1423	2578	IR	Hy	2M	4500	EL	C,G	10.0	2000	Ba,Pi	Ct	McK	Co	SA	P	CE	8	Pn,Hyd	ASH	Ro,Ret	St	DP	El	RC	375
19	2020	6300[18]	BJ	Hy	3M	3650	GE	Oil	18.1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Ret	St	DP	Me	PD	254
20	1755	2490	PP	R	3M	3500	AC	Gas	1018[26]	.....	Pi	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	181
21	2000	2500	BJ	R	3M	3500	EL	O,G	18.0	.....	RR,Pi	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	178
22	2000	2500	BJ	R	3M	3500	EL	O,G	18.0	.....	RR,Pi	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	178
23	1216	2300	IR	Hy	3M	2000	WE	C,G	13.0	2300	Ba,Pi	Ct	HP	Co,Bu,Sc	CB	Cy	BW	.....	Hyd	UC	Ro,Ret	Air	DP	None	.....	.....
24	1800[27]	5800[18]	WO	Hy	1M 1T	3000 7000	GE	G	926[26]	.....	Pi	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	161
25	1975	2600	PP	R	3M	4000	GE	G	1020[26]	.....	Pi	N	.....	.....	.....	.....	.....	.....	.....	.....	N	.....	.....	.....	.....	182
26	1450	2267	PP	Hy	2M	2500	WE	O,G	19.0	.....	RR,Tr,Pi	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	63
27	756[27]	.....	R	2M	.....	WE	C	10.0	2667	RR	.....[30]	Ex	Co	Ex	P	CE	5	Pn,Hyd	.....	Ro,Ret	St	CV	Me	AB	.....
28	1075	4950[18]	AC	Hy	2M	1625	GE	G	1097[26]	.....	Pi	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	178
29	1075	4950[18]	AC	Hy	2M	1625	GE	G	1097[26]	.....	Pi	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	178
30	.....	.....	PP	.....	2M	.....	.....	C-s	9.2	2485	.....	.....	.....	.....	.....	P	RS	3	.....	.....	Ro,Ret	Air	DP	Me	WP	.....
31	.....	.....	PP	.....	2M	.....	.....	C-s	9.2	2485	.....	.....	.....	.....	.....	P	RS	3	.....	.....	Ro,Ret	Air	DP	Me	WP	.....
32	1485	1890	PP	R	2M	2250	GE	C	13.2	2100	RR	CS	HR	Co,Bu	HR	P	CE	5	Hyd	UC	Ro,Ret	Air	DP	Me	PD	250
33	1550	2200	PP	Hy	2M	2500	GE	G	1078[26]	.....	Pi	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
34	1550	2200	PP	Hy	2M	2500	GE	G	1078[26]	.....	Pi	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
35	1080	2350	BJ	Hy	2.5M	2000	EM	O,G	18.2	....	Sh,Pi	.....	.....	.....	.....	.....	.....	.....	.....	.....	Ret	St	CV	None	.....	300
36	1400	2200	BJ	S,Hy	2M	2250	GE	C,G	12.8	2550	Ba,Pi	Wc	CIW	Co,Bu	CON	P	CE	4	Hyd	UC	Ro,Ret	St	CV	Me	BU	184
37	1900	2200	IR	R	2M	3000	WE	O,G	18.8	.....	RR,Pi	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
38	1900	2200	IR	R	2M	3000	WE	O,G	18.8	.....	RR,Pi	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
39	970	2895	IR	Hy	3M	1750	GE	C,O	13.2	2400	RR	CS	AC	Co,Bu	SA	P	RS	4	Hyd	UC	Ro,Ret	St	DP	El	RC	207
40	960	2180	IR	Hy	2M	1750	GE	C,G	10.4	2000	RR	CS	AC	Co	FE	P	CE	4	Hyd	UC	Ret	Air	DP	Me	GF	193
41	1320	2200	IR	R	2M	2250	WE	G	1035[26]	.....	Pi	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	125
42	.....	.....	IR	R	2M	2500	GE	C,G	13.0	.....	RR,Pi	.....	.....	.....	.....	P	CE	4	Hyd	UC	Sta,Ro Ret	Air	CV	.....	.....	.....
43	1600	2200	IR	R	2M	2500	GE	C	10.0	2200	RR,Tr	.....	.....	Co	SA	P	CE	5	Pn,Hyd	UC	Ro,Ret	St	CV	Me	AB	250
44	1600	2200	IR	R	2M	2500	GE	C	10.0	2200	RR,Tr	.....	.....	.....	.....	P	CE	5	.....	.....	Ro,Ret	St	CV	Me	AB	250
45	1520	2270	PP	R	2M	2250	GE	C	12.9	2000	RR	CS,Dump	.....	Co,Bu	SA	P	CE	5	Pn,Hyd	.....	Ro,Ret	Air	.....	Me,El	BU	.....
46	1280	2420	PP	R	2M	2250	GE	C	12.9	2000	Ba	Ct	CSM	Co	SA	P	CE	5	Pn,Hyd	ASH	Ret	Air	CV	Me,El	BU	425
47	1030	2506	IR	R	3M	1750	EL	C,O	13.8	2650	Sn	Ct	McK	Co,Bu	SA	P	CE	4	Pn,Hyd	ASH,UC	Ro,Ret	St	CV	Me	WP	241
48	1300	2400	AC	R	3M	2500	WE	C	10.9	2690	RR	CS	SA	Co	SA	P	RS	4	Pn	ASH	Ro,Ret	Air	DP	Me	WP	300
49	1335	2294	AC	Hy	3M	2250	GE	C	11.8	2100	Ba	Ct	HP	Co	HR	P	RS	3	Hyd	UC	Ro,Ret	Air	CV	Me,El	APC	550
50	1335	2294	AC	Hy	3M	2250	GE	C	11.8	2100	Ba	Ct	HP	Co	HR	P	RS	3	Hyd	UC	Ro,Ret	Air	CV	Me,El	APC	550
51	992	2350	IR	Hy	2M	1750	WE	C	12.3	2100	RR	CS	WEB	Co,Bu	WEB	Cy	BW	.....	Pn,Hyd	UC	Sta,Ro, Ret	St	DP	El	AT	225

MANUFACTURERS (Continued)

RCA - Radio Corporation of America
RF - Republic Flow Meters Co
RHE - Ross Heat Exchanger Div
RS - Riley Stoker Corp
SA - Stephans-Adamson Mfg Co
SB - Sulzer Brothers Ltd
SW - Sturtevant Div, Westinghouse Electric Corp
UC - United Conveyor Co
WE - Westinghouse Electric Corp
WEB - Webster Engineering Co
WL - Wellman Conveyors
WO - Worthington Corp
WP - Western Precipitation Corp
YU - Yuba Heat Transfer Div

SYMBOLS USED ABOVE

AAB - Arsenical Aluminum Brass
Ad - Admiralty
Adl - Admiralty, Inhibited
Al - Aluminum
AsCu - Arsenical Copper
Ba - Barge
Bu - Bulldozer
BuU - Bucket unloader
C - Coal, bituminous
CC - Cross compound
CNi - Cupro Nickel
Co - Conveyor
CS - Car shaker
C-s - Coal, sub-bituminous
Ct - Coal tower
Cy - Cyclone
De - Demineralizer
Dump - Dumper
El - Electrostatic
Ev - Evaporator
Ex - Existing
G - Gas
GC - Gas cooled
H - Heater
H_2 - Hydrogen
HC - Hollow conductor
Hot - Condenser hotwell
Hy - Hydraulic coupling

HEATER					CONDENSER								TURBINES									CONTROLS						
Number	Hi-press heater exit temp, F	Max deaerating press, psia	Manufacturer	Deaeration	Surface, 1000 sq ft	No. of water passes	Tube Material	Air removal	Manufacturer	Feedwater treatment (raw water)	Feedwater pH	System manufacturer	Number	Capability each, 1000 kw	Turbine type	Manufacturer	Exhaust pressure, psia	No. of bleedpoints	No. main turbine exhausts	Main generator voltage, kv	Generator rating, 1000 kva (mva)	Generator cooling	Combustion control mfr	Feedwater control mfr	Closed-circuit TV mfr	Total boiler capacity incl. new units, 1000 lb per hr	Total generator capability incl. new units, 1000 kw	
8	560	117	AP	H,Hot	113	1	Ad	J,Ro	AC	De	9.0	COC	1	215	TC	WE	0.5	8	3	22	274	H_2	LN	SB	DP	.....	670	1
7	488	101	.....	H	130	2	.....	J	IR	So,Ev	9.0	.....	1	235	TC	GE	0.75	7	1	22	281	H_2,Li	.....	.....	.....	3650	463	2
6	480	119	GR	H	105	1	.....	RP	WO	De	9.5	GW	1	190	TC	GE	0.75	6	3	20	234	H_2,HC Li	BM	BM	N	1357	190	3
7	459	140	GR	H	90	2	Ad	Ro	AC	So,Ev	9.0	Ex	1	130	TC	GE	0.75	6	2	16	173	H_2	LN	CE,SB	RCA	3380	460	4
7	479	N	CFB	Hot	170	1	Ad.	RP	AC	De	9.2	COC	1	325	CC	WE	0.5	7	2	18	...[23]	H_2,HC	BM	BM	N	8480	1275	5
7	464	.....	RHE	Hot	160	2	Ad1	J	CHW	De	.....	.....	1	295	CC	GE	0.75	7	1	16	320	H_2	BM	BM	DP	7720	1175	6
8	532	1.0	GR	Hot	90	2	Ad1	RP	WO	De	8.8	IN	2	170	TC	GE	0.75	8	3	20	206	H_2	BM	BM	N	1250	170	7
8	532	1.0	GR	Hot	90	2	Ad1	RP	WO	De	8.8	IN	2	170	TC	GE	0.75	8	3	20	206	H_2	BM	BM	N	2500	340	8
8	525	1.0	GR	Hot	90	2	Ad1	RP	WO	De	8.8	IN	2	170	.....	.....	.....	.....	.....	.....	.....	.....	BM	BM	N	3750	510	9
8	525	1.0	GR	Hot	90	2	Ad1	RP	WO	De	8.8	IN	2	170	.....	.....	.....	.....	.....	.....	.....	.....	BM	BM	N	5000	680	10
7	458	83.1	FW,WE	H	150	2	Ad	J	WE	So,Ev	9.0	.....	1[24]	300	CC	WE	0.75	7	2	18	367	H_2,HC GC	LN	BM	N	2100	300	11
8	530	.....	YU	Hot	150	1	Ad	Ro	FW	De	9.0	COC	1	320	CC	GE	0.61	8	6	18	384	H_2	BM	BM	.....	4120	640	12
8	530	.....	YU	Hot	150	1	Ad	Ro	FW	De	9.0	COC	1	320	CC	GE	0.61	8	6	18	384	H_2	BM	BM	.....	4120	640	13
7	515	130	WE	H	.....	.....	.....	RP	WE	De	8.8	.....	1	137.5	TC	GE	0.75	7	1	13.8	172.8	H_2	RF	RF	.....	910	137.5	14
11	450	.....	.....	Hot	159	1	Al	J	AC	De	7	.....	1	275	CC	AC	2.5	7	2	.....	.....	.....	.....	.....	.....	7080	850	15
6	461	119	AP,RHE, FW	H	75	1	AAB	J	FW	De	7.6	PM	1[25]	150	TC	GE	1.88	6	2	20	192	H_2,Li	BM	BM	DP	1770	282	16
7	458	62.6	YU	H	165	2	.....	Ro	YU	De	.....	MR	1[26]	357	TC	WE	0.75	7	4	24	384	H_2	HCC	HCC	N	2300	357	17
10	473	100	Var	H,Hot	210	1	.....	J	FW	De	9.2	IN	1	325	CC	WE	0.5	7	2	12.6	407	H_2,HC	RF	BM	DP	5570	665	18
6	.....	.....	YU	H	110	1	Al,Br	Ro	FW	De	.....	.....	1[24]	240	TC	WE	1.3	7	1	22	265	H_2	BM	BM	.....	1600	240	19
7	470	129	CFB	H	145	1	Ad1	Ro	FW	De	7.0	.....	1[24]	275	TC	WE	2.0	7	3	24	352	H_2,HC Li	BM	BM	N	4350	615	20
7	470	130	CFB	H	130	2	Ad1	Ro	CHW	De	.....	.....	1[24]	220	TC	AC	1.8	7	3	22	265	H_2	RF	RF	.....	2200	290	21
7	460	130	CFB	H	110	1	AAB	Ro	FW	De	.....	.....	1[24]	220	TC	GE	1.8	7	3	16.5	265	H_2,Li	RF	RF	.....	5500	770	22
7	552	88	YU	H,Hot	80	1	CNi	J	WE	De	8.0	GW	1	142	TC	WE	0.5	6	3	18	156	H_2,HC	HCC	HCC	N	.....	.....	23
7	474	.....	CFB	Hot	110	1	Al	Ro	RHE	De	7.0	GW	1[24]	225	TC	GE	1.8	7	3	22	265	H_2	DS	DS	.....	1550	225	24
7	420	151	FW	H	115	1	Ad	Ro	FW	De	9.0	.....	1[24]	220	TC	AC	1.8		3	20	309	H_2[28]	RF	RF	N	1550	220	25
5	460	.....	.....	Hot	45	2	AsCu	J	IR	De	.....	LA	1[29]	75	TC	GE	1.0	5	2	13.8	102	H_2	BM	Var	N	.....	.....	26
6	473	158	.....	H	.....	.....	.....	J	WE	De	10	.....	1[24]	175	SC,TC	WE	0.75	.....	2	18.0	190	H_2,Li	.....	.....	.....	3780	525	27
5	468	87.4	WO	H	65	2	AsCu	J	WO	De	8.5	GW	1[24]	110	TC	WE	1.8	5	1	13.8	134	H_2	BM	AP	.....	800	110	28
5	468	87.4	WO	H	65	2	AsCu	J	WO	De	8.5	GW	1[24]	110	TC	WE	1.8	5	1	13.8	134	H_2	BM	AP	.....	1600	220	29
6	481	.....	....	.....	100	2	.....	J	WO	.....	.....	.....	1[24]	175	TC	GE	1.75	6	1	.....	192	GC,Li	.....	.....	.....	1270	175	30
6	481	.....	.....	.....	100	2	.....	J	WO	.....	.....	.....	1[24]	175	TC	GE	0.75	6	2	.....	192	GC,Li	.....	.....	.....	2540	350	31
7	468	.....	CFB	Hot	105	2	Al	Ro	YU	So,Ev	7.6	MR	1[24]	195	TC	GE	1.8	7	1	18	221	H_2,Li	HCC	HCC	DP	1350	195	32
5	470	140	YU	H	70	1	Ad	Ro	YU	So,Ev	.....	MR	1[24]	156	TC	GE	0.75	6	2	13.8	221	H_2	BM	BM	N	1260	175	33
5	470	140	GR	H	70	1	.....	Ro	FW	So,Ev	.....	.....	1[24]	156	TC	WE	1.8	6	2	18	201	H_2	.....	.....	N	2520	350	34
6	507	90	YU	H	80	1	CNi	J	FW	De	9.0	....	1	121	TC	GE	1.0	6	2	15.5	150	H_2	RF	RF	DP	1800	242	35
5	451	100	GR	H	60	2	....	RP	CHW	De	.....	.....	1	75	TC	AC	1.0	5	.....	13.8	111	H_2	HCC	HCC	.....	1949	225	36
6	479	.....	WE	Hot	110	1	CNi	Ro	WE	De,So	9.0	.....	1	230	TC	WE	1.75	6	1	20	256	H_2,HC	BM	BM	.....	1584	230	37
6	479	.....	WE	Hot	110	1	CNi	Ro	WE	De,So	9.0	.....	1	230	TC	WE	1.75	6	1	20	256	H_2,HC	BM	BM	.....	3168	460	38
6	458	87	EL	H,Hot	75	2	Ad	J,Ro	WE	De	9.0	HL	1	116	TC	GE	1.8	6	1	13.8	134	H_2	BM	BM	N	1400	188	39
6	445	115	AP	H	72.5	2	Ad	J	FW	De	.....	.....	1	125	TC	GE	0.75	6	.....	15	160	H_2	HCC	HCC	N	2420	262	40
6	443	331	YU	H	85	2	Ad	Ro	FW	De	10.4	MR	1[26]	135	TC	WE	1.3	6	1	16	160	H_2	BM	BM	GE	1070	167	41
6	500	.....	GR	Hot	70	1	Ad	J	CHW	De	8.8	PM	1	125	TC	GE	0.75	6	2	14.4	134	H_2	BM	BM	GE	1800	225	42
7	468	133	EL	H	70	1	Al	J	YU	De	.....	.....	1[26]	175	SC,TC	GE	0.75	7	1	22	201	Li	BM	BM	DP	2520	350	43
7	477	150	.....	H	70	1	.....	J	....	De	.....	.....	1[24]	175	SC,TC	....	0.75	7	1	.....	.....	.....	.....	.....	.....	3780	525	44
6	455	.....	GR	Hot	70	1	Al,Br	J	WO	Ev	8.0	.....	1[24]	156	TC	GE	0.75	6	1	20	176	H_2	HCC	HCC	DP	2650	370	45
6	455	.....	GR	Hot	70	1	Al,Br	J	WO	Ev	7.0	MR	1[24]	156	TC	GE	0.75	6	3	20	176	H_2	HCC	HCC	DP	3590	475	46
6	460	87.6	WE,GR	H	75	2	CNi	J	WE	Ev	10.5	PJ	1[25]	122	TC	GE	0.75	6	2	15.5	147	H_2	HCC	CV	DP	2995	330	47
8	516	45	YU	H	55	1	Ad1	J	YU	So,Ev	11.0	MR	1	170	TC	GE	0.75	8	1	20	182	H_2,HC Li	BM	BM	N	2644	403	48
7	450	105	AP	H	85	2	Ad	J	CHW	De	.....	.....	1	150	TC	AC	0.75	6	1	18	176	H_2,HC	LN	RF	N	2200	300	49
7	450	105	AP	H	85	2	Ad	J	CHW	De	.....	.....	1	150	TC	GE	0.75	6	1	18	176	H_2,HC	LN	RF	N	4400	600	50
6	468	100	AWS	H	75	2	Al	J	WE	De	9.0	COC	1[29]	123	TC	WE	0.5	6	2	14.4	134	H_2	FC	COC	N	815	123	51

Hyd - Hydraulic
J - Steam jet
Li - Liquid
M - Motor
Ma - Magnetic coupling
Me - Mechanical
N - None
O - OH
P - Pulverizer

Pl - Pipeline
Pn - Pneumatic
R - Regulator
Ret - Retractable
Ro - Rotary pump or blower
RP - Reciprocating pump
RR - Railroad
S - Speed control
Sb - Self unloading boat

SC - Single cylinder
Sc - Scraper
Sh - Ship
So - Softener
St - Steam
Sta - Stationary
T - Turbine drive
TC - Tandem compound

Tr - Truck
Uc - Underground conveyer
Var - Various
Wc - Whirley crane
18 - Feet
19 - Half size spare
20 - Crushers
21 - Fly ash reinjected dry to cyclones

22 - Above roof
23 - 208 Hp, 170 Lp
24 - Outdoor unit
25 - Preferred standard
26 - Btu per cu ft
27 - 1000 lb per hr
28 - Supercharged
29 - Low head enclosure
30 - Underground unloading hopper

TABLE 2

1959 design survey of typical

Compiled by:
J. W. Follansbee, Assistant Editor

Project Number	Company	Location	Plant Name	Consulting Engineers	Unit No., new unit	First operation, new unit	Throttle pressure, psig	Steam temperature, F		Number	Capacity each, 1000 lb per hr	
								Throttle	Reheat			
52	Rochester Gas & Electric Corp	Rochester, N Y	Beebee	Gilbert Associates, Inc	12[1]	8-59	1800	1050	1000	1	557	
53	Texas Power & Light Co	Fannin County, Tex	Valley	Ebasco Services, Inc	1	1-62	1800	1000	1000	1[2]	1250	
54	Columbus & Southern Ohio Electric Co	Conesville, Ohio	Conesville	Ebasco Services, Inc	2[1]	2-59	1450	1000	1000	1[2]	1000	
55	El Paso Electric Co	Newman, Tex	Newman	Stone & Webster Engrg Corp	1[4]	1960	1450	1005	1005	1[2]	560	
56	Iowa Electric Light & Power Co	Marshalltown, Ia	Sutherland		3	6-61	1450	1000	1000	1	600	
57	Minnesota Power & Light Co	Cohasset, Minn	Clay Boswell	Ebasco Services Inc	2[1]	9-59	1450	1000	1000	1[2]	500	
58	Pacific Power & Light Co	Glenrock, Wy	Dave Johnston	Ebasco Services, Inc	2	10-60	1450	1000	1000	1[6]	750	
59	Savannah Electric & Power Co	Port Wentworth, Ga	Port Wentworth	Stone & Webster Engrg Corp	2	5-61	1450	1000	1000	1[2]	375	
60	Southwestern Public Service Co	Amarillo, Tex	Nichols		1	6-60	1450	1000	1000	1[2]	800	
61	West Texas Utilities Co	Oak Creek, Tex	Oak Creek	Sargent & Lundy	1	4-62	1450	1005	1005	1[6]	525	
62	Madison Gas & Electric Co	Madison, Wis	Blount Street	Pioneer Service & Engrg Co	7	4-61	1250	950	.....	1	425	
63	Missouri Public Service Co	Sibley, Mo	Sibley	Burns & McDonnell Engrg Co	1[1]	4-60	1250	950	.....	1[6]	450	
64	Missouri Public Service Co	Sibley, Mo	Sibley	Burns & McDonnell Engrg Co	2[4]	3-61	1250	950	.....	1[6]	450	
65	United Gas Improvement Co	Hunlock Creek, Pa	Hunlock	United Engineers & Constructors	3[1]	12-59	1250	950	.....	1	400	
	MUNICIPAL, FEDERAL AND COOPERATIVE INSTALLATIONS											
66	Memphis Light, Gas & Water Div	Memphis, Tenn	Thomas H. Allen	Burns & Roe, Inc	1	1959	2400	1050	1050	1	2000	
67	Memphis Light, Gas & Water Div	Memphis, Tenn	Thomas H. Allen	Burns & Roe, Inc	2	1959	2400	1050	1050	1	2000	
68	Memphis Light, Gas & Water Div	Memphis, Tenn	Thomas H. Allen	Burns & Roe, Inc	3	1959	2400	1050	1050	1	2000	
69	Los Angeles Dept of Water & Power	Seal Beach, Cal	Haynes	A. G. Christie	1	8-62	2000	1000	1000	1[2]	1510	
70	Los Angeles Dept of Water & Power	Seal Beach, Cal	Haynes	A. G. Christie	2	8-63	2000	1000	1000	1[2]	1510	
71	Omaha Public Power District	Omaha, Neb	North Omaha	Pioneer Service & Engineering Co	4	.....	2000	1000	1000	1	950	
72	Holyoke Water Power Co	Holyoke, Mass	Mount Tom	Jackson & Moreland Inc	1	7-60	1800	1000	1000	1[6]	950	
73	City of Austin	Austin, Texas	Holly Street	Brown & Root	2	7-60	1525	1000	1000	1[2]	800	
74	Dairyland Power Coop	Alma, Wisconsin	Alma	Vern E. Alden	5[1]	10-59	1450	1000	1000	1	580	
75	Kansas City Board of Public Utilities	Kansas City, Kan	Kaw	Burns & McDonnell Engrg Co	3	4-62	1450	1005	1005	1[6]	425	
76	City of San Antonio	San Antonio, Tex		Gibbs & Hill, Inc	3	5-61	1450	1005	1005	1[2]	800	
77	Central Electric Power Coop	Chamois, Mo	Chamois	Larrimore, Douglass & Popham	2	4-60	1250	955	.....	1[2]	416	
78	E Kentucky Rural Electric Coop Corp	Ford, Ky	Wm. C. Dale	Stanley Engineering Co	4[4]	10-60	1250	955	.....	1[6]	623	
79	City of Burbank	Burbank, Cal	Olive Ave	Fluor Corp	1[4]	9-59	1250	955	.....	1[6]	425	
80	Western Farmers Electric Coop	Anadarko, Okla	Anadarko	Larrimore, Douglass & Popham	3	8-59	1250	955	.....	3[2]	458	
81	City of Monroe	Monroe, La	Municipal	Ford, Bacon & Davis, Inc	10	1-61	890	905	.....	1[6]	250	
82	Corn Belt Power Coop	Spencer, Iowa	Earl F. Wisdom	Stanley Engineering Co	1[4]	5-60	875	905	.....	1	335	
83	City of Springfield	Springfield, Ill	Lakeside	Burns & McDonnell Engrg Co	6[4]	.....	875	910	.....	1	320	
84	City of Vineland	Vineland, N J	Municipal	A. C. Wood Assoc, Inc	9	6-60	875	910	.....	1	180	
85	Consumers Public Power District	Hallam, Neb	Sheldon	Stearns-Roger Mfg Co	1[4]	4-61	1450	1000	1000	1[6,8]	790	
86	City of Garland	Garland, Texas	East Side	Tippett & Gee	3	3-60	850	900	.....	1[2]	185	
87	City of Garland	Garland, Texas	East Side	Tippett & Gee	4	4-61	850	900	.....	1[2]	185	
88	City of Hamilton	Hamilton, Ohio	Municipal	Emery, Marker & Campbell	7[1]	12-59	850	900	.....	1	195	
89	City of Lakeland	Lakeland, Fla	Larsen	Wellman-Lord Inc	6	11-59	850	900	.....	1	240	
90	Lea County Electric Coop	Lovington, N M		Tippett & Gee	1	1960	850	900	.....	1[2]	185	
91	City of Muscatine	Muscatine, Ia	Municipal	Stanley Engineering Co	7[1]	7-59	850	900	.....	1[6]	235	
92	City of Wyandotte	Wyandotte, Mich	Municipal	Emery, Marker & Campbell	5	3-59	850	900	.....	1	195	
93	City of Ames	Ames, Ia	Municipal	Burns & McDonnell Engrg Co	6	10-58	600	825	.....	1	125	
94	City of Grand Haven	Grand Haven, Mich	Island	Lutz & May	1	4-61	600	825	.....	1	125	
95	City of Grand Haven	Grand Haven, Mich	Island	Lutz & May	2	4-61	600	825	.....	1	125	
96	City of Stillwater	Stillwater, Okla	Boomer Lake	C. H. Guernsey	2	11-59	600	825	.....	1[6]	150	
97	City of Clarksdale	Clarksdale, Miss	South		7	4-61	425	765	.....	1[2]	100	

SYMBOLS USED ABOVE

- At - Attemperator
- By - Gas bypass
- Cool - Cooling coils
- Cool - Boiler water cooling
- D - Damper
- DB - Dry bottom
- Du - Dual drive
- FG - Flue gas recirculation
- Hy - Hydraulic coupling
- M - Motor
- Ma - Magnetic coupling
- Mp - Two motors per fan
- N - None
- Pd - Pressurized
- Pre - Precondensing
- Re - Regenerative
- ST - Slag tap
- T - Turbine
- TB - Tilting burners
- Tu - Tubular
- V - Vane control
- WB - Wet bottom
- WS - Water spray
- 1 - Revised data, previously listed 12-57
- 2 - Outdoor unit
- 3 - Gas proportioning dampers
- 4 - Revised data, previously listed 10-58
- 5 - Overriding water spray
- 6 - Semioutdoor unit
- 7 - Cyclones
- 8 - Boiler operates initially at 850 psig, 900 F

MANUFACTURERS

- AB - American Blower Corp
- AC - Allis-Chalmers Mfg Co
- AP - Alco Products, Inc
- ASH - Allen-Sherman-Hoff Co
- AT - Aerotec Corp
- AWS - American Water Softener Co
- BB - Brown Boveri Ltd
- BI - Beloit Industrial Equipment
- BF - Buffalo Forge Co
- BJ - Byron-Jackson Pumps, Inc
- BL - Belz Laboratories
- BM - Bailey Meter Co
- BP - Bingham Pumps
- BU - Buell Engineering Co, Inc
- BW - Babcock & Wilcox Co
- CE - Combustion Engineering, Inc
- CF - Clarage Fan Co
- CFB - C F Braun Co
- CH - Chicago Heater Co
- CHW - C H Wheeler Mfg Co
- CIW - Clyde Iron Works
- COC - Cochrane Corp

new central-station installations

Project Number	Manufacturer	BOILERS: Surface, 1000 sq ft: Boiler & Waterwalls	Superheater	Reheater	Economizer	Air heater	Superheat control	Reheat control	Air heater type	FURNACE: Pressure, in. of water	Volume, 1000 cu ft	Heat release, 1000 Btu per cu ft per hr	No. of burners	Bottom	F-D FANS: No. per boiler	Capacity each, 1000 cfm	Manufacturer	Air flow control	Drive	Drive hp	Drive manufacturer	I-D FANS: No. per boiler	Capacity each, 1000 cfm	Manufacturer	Gas-flow control	Drive	Drive hp	Drive manufacturer
52	CE	17.9	54.1	8.4	11.4	57.9	WS,TB	WS	Re	.....	54.0	14.0	12	.....	1	222	SW	V	M	500	WE	1	290	SW	D	M	900	WE
53	BW	13.4	33.9	18.6	19.8	306	WS	WS,D[3]	Re	19.1	50.4	34.5	9	DB,Pd	2	185	AB	V	M	1750	EL	None	.....	.....	.....	.....	.....	.....
54	BW	23.0	92.7	17.2	N	144	WS	WS	Re	12.3	48	28	4	ST	2	149	EL	V	M	2000	WE	None	.....	.....	.....	.....	.....	.....
55	BW	10.6	17.7	6.9	17.5	84.4	WS	WS	.....	10.0	26.6	30.0	12	Pd	1	219	SW	V	M	1000	WE	None	.....	.....	.....	.....	.....	.....
56	BW	12.1	.....	.....	12.8	114	WS,FG	WS	Re	10.8	30.8	.....	3[7]	ST,Pd	2	107	SW	V	M	1000	AC	None	.....	.....	.....	.....	.....	.....
57	RS	37.8	28.5	19.5	9.3	98	WS[5] By	WS[5] D	Re	-0.10	39.0	17.7	8	DB	1	145	CF	V	M	356	GE	1	225	CF	D	M	770	GE
58	BW	30.5	52.4	22.8	16.1	76.3	WS	WS	PI	-0.3	80.6	13.3	18	DB	2	141	SW	V	M	450	GE	2	255	SW	D	M	700	GE
59	CE	12.4	23.0	4.3	13.4	56.1	WS,TB	WS,TB	Re	-0.15	32.0	19.0	8	DB	1	135	SW	D,V	M	350	GE	1	210	GF	D,V	M	700	GE
60	CE	21.1	.....	.....	18.3	58.1	WS,TB	WS,TB	Re	11.6	47.7	20.1	32	Pd	2	161	SW	D,V	M	800	WE	None	.....	.....	.....	.....	.....	.....
61	BW	10.6	13.2	6.9	16.4	77	WS	WS	Re	15.3	26.6	27.6	12	Pd	1	200	SW	V	M	1000	WE	None	.....	.....	.....	.....	.....	.....
62	BW	5.9	21.0	N	10.0	75	WS	.....	Re	.....	.....	.....	.....	DB	1	.....	.....	Hy	M	.....	.....	1	.....	.....	Hy	M	.....	.....
63	BW	8.5	.....	.....	6.9	110	WS	.....	Tu	7.5	18.2	.....	2	ST,Pd	1	75	SW	V	M	1500	GE	None	.....	.....	.....	.....	.....	.....
64	BW	8.5	.....	.....	6.9	110	WS	.....	Tu	7.5	18.2	.....	2	ST,Pd	1	75	SW	V	M	1500	GE	None	.....	.....	.....	.....	.....	.....
65	FW	17.9	14.5	.....	3.7	115	Pre	.....	Re	0.3	60.9	10.2	12	WB	2	83	SW	V	M	200	WE	2	130	SW	D	M	600	WE
66	BW	41.9	51.3	104.6	36.5	201	WS,FG	WS,D[3]	Re	15.0	75.8	31.9	7[7]	ST,Pd	2	250	SW	D	M	4000	GE	None	.....	.....	.....	.....	.....	.....
67	BW	41.9	51.3	104.6	36.5	201	WS,FG	WS,D[3]	Re	15.0	75.8	31.9	7[7]	ST,Pd	2	250	SW	D	M	4000	GE	None	.....	.....	.....	.....	.....	.....
68	BW	41.9	51.3	104.6	36.5	201	WS,FG	WS,D[3]	Re	15.0	75.8	31.9	7[7]	ST,Pd	2	250	SW	D	M	4000	GE	None	.....	.....	.....	.....	.....	.....
69	CE	21	76	18	42	296	WS,FG	FG	Re	8.0	92.5	19.1	12	DB,Pd	2	225	.....	Hy	M	1500	.....	None	.....	.....	.....	.....	.....	.....
70	CE	21	76	18	42	296	WS,FG	FG	Re	8.0	92.5	19.1	12	DB,Pd	2	225	.....	Hy	M	1500	.....	None	.....	.....	.....	.....	.....	.....
71	CE	16.5	80.0	17.4	26.2	183	WS,TB	WS,TB	Re	-0.10	115	11.3	16	DB	2	188	AB	Ma	M	500	GE	2	230	SW	Ma	M	1000	GE
72	RS	42.3	59.2	36.3	11.0	181	WS,By	WS,By	Re	-0.10	75.3	16.8	16	DB	2	158	SW	V	M	600	WE	2	222	SW	V	M	1200	WE
73	CE	18.6	26.7	6.5	18.3	188	TB	TB	Re	10.25	48.0	23.1	32	Pd	2	117	SW	V	M	600	WE	None	.....	.....	.....	.....	.....	.....
74	RS	35.4	33.5	29.4	6.5	108	WS	WS	Re	8.8	52.9	14.9	8	DB	2	113	AB	Hy	M	350	EM	2	170	AB	Hy	M	600	EM
75	BW	18.2	34.3	12.7	7.3	47.1	FG	WS,FG	Re	.....	231	22.6	2[7]	ST	2	346	SW	D	Du	1000	WE	None	.....	.....	.....	.....	.....	.....
76	RS	13.2	32.9	28.3	11.8	163	WS,By	WS,D	Re	17.0	41.5	27.2	12	Pd	2	247	SW	V	M	600	EL	None	.....	.....	.....	.....	.....	.....
77	BW	7.1	.....	.....	10b	110	WS	.....	Tu	9.2	18.2	.....	2[7]	ST,Pd	1	133	SW	D	M	1500	AC	None	.....	.....	.....	.....	.....	.....
78	BW	11.8	.....	.....	20.9	139	WS	.....	Re	24	43.9	18.5	9	DB,Pd	2	480	GF	D,Hy	M	600	GE	None	.....	.....	.....	.....	.....	.....
79	RS	32.3	4.0	.....	.....	24.7	WS	.....	.....	6.0	18.5	28.4	6	Pd	2	71	SW	D	M	350	WE	None	.....	.....	.....	.....	.....	.....
80	RS	.....	.....	.....	.....	.....	WS	.....	Re	12	.....	.....	.....	Pd	1	.....	GF	V	Mp	500/100	EL	None	.....	.....	.....	.....	.....	.....
81	BW	16.6	.....	.....	22.8	None	WS	.....	.....	4.2	8.93	38.0	8	Pd	2	51	SW	.....	M,T	125	.....	None	.....	.....	.....	.....	.....	.....
82	RS	27.5	15.0	.....	.....	38.2	Coil	.....	Re	.....	39.0	18.0	6	DB	1	509	AB	V	M	350	EM	1	552	AB	S,V	M	660	EM
83	BW	17.7	13.0	.....	.....	47.8	At	.....	Re	8	7.6	.....	2[7]	ST,Pd	1	96	SW	V	M	1000	WE	None	.....	.....	.....	.....	.....	.....
84	CE	21.2	14.0	.....	.....	21.3	WS	.....	Tu	.....	8.7	33.0	4	DB	1	.....	SW	V	M	150	WE	1	.....	SW	D	M	350	WE
85	BW	22.8	52.2	14.5	7.8	84	WS,FG	WS	Re	13.0	29.3	33	3[7]	St,Pd	2	132	SW	D,V	M	2000	WE	None	.....	.....	.....	.....	.....	.....
86	BW	14.1	3.5	.....	.....	39	WS	.....	Re	10	6.0	36.8	4	Pd	1	65	SW	V	Mp	300/50	GE,EM	None	.....	.....	.....	.....	.....	.....
87	BW	14.1	3.5	.....	.....	39	WS	.....	Re	10	6.0	36.8	4	Pd	1	65	SW	V	Mp	300/50	GE,EM	None	.....	.....	.....	.....	.....	.....
88	WI	28.5	8.3	.....	5.2	12.3	WS	.....	Tu	-0.10	11.0	30	.....	DB	1	88	SW	D	Du	150/85	WE,EL	1	133	BF	D,Hy	Du	350	WE,EL
89	BW	17.6	5.0	.....	.....	27.7	WS	.....	Tu	-0.2	12.9	24.7	6	DB	1	125	GF	D	Du	150	GE,WO	1	144	GF	D	Du	250	GE,TE
90	BW	11.7	5.3	.....	.....	37.9	WS	.....	Re	10	8.1	27.7	4	Pd	1	59	SW	V	M	350	WE	.....	.....	.....	.....	.....	.....	.....
91	WI	18.7	8.5	.....	10.1	12.3	Coil	.....	Tu	-0.10	11.7	25.9	4	.....	1	80	SW	D	M	200	GE	1	138	SW	Hy	M	450	GE
92	BW	22.5	8.5	.....	3.7	10.0	WS	.....	Tu	-0.1	11.24	26.2	.....	.....	1	80	GF	V	Du	150/85	EL	1	149	GF	D,Ma	Du	350	EL
93	UI	12.1	4.8	.....	14.5	.....	Cool	.....	.....	0.15	6.4	25.4	4	.....	1	41	AB	Hy	M	60	GE	1	74	AB	Hy	M	260	GE
94	EC	13.6	3.1	.....	16.7	.....	None	.....	.....	-0.15	6.5	26.1	4	.....	1	41	AB	D	M	40	.....	1	72	AB	D	Mp	200/100	.....
95	EC	13.6	3.1	.....	16.7	.....	None	.....	.....	-0.15	6.5	26.1	4	.....	1	41	AB	D	M	40	.....	1	72	AB	D	Mp	200/100	.....
96	EC	13.0	3.3	.....	.....	10.4	WS	.....	Re	6.4	5.4	33	4	Pd	1	49	SW	V	Mp	200/40	AC	None	.....	.....	.....	.....	.....	.....
97	CE	7.4	5.1	.....	.....	7.9	None	.....	Re	10.0	2.6	131	8	DB,Pd	1	29	SW	V	M	300	GE	None	.....	.....	.....	.....	.....	.....

COS - Condenser Service Div
CV - Copes-Vulcan Div, Blaw-Knox Co
DuM - DuMont TV Rec'r Div
DC - Duge Co
DE - Davis Engineering
DP - Diamond Power Specialty Corp
DR - Dravo Corp
DSC - Detroit Stoker Co
EC - Erie City Iron Works
ECA - Electronic Corp of America
EE - English Electric Co, Ltd
EL - Elliott Co
EM - Electric Machinery Mfg Co
FA - Fly Ash Arrestor Corp
FE - Fairfield Engineering Co
FW - Foster Wheeler Corp
GE - General Electric Co
GF - Green Fuel Economizer Co, Inc
GW - Gifford Wood Co
GR - Griscom-Russell Co
GW - Graver Water Conditioning Co
HCC - Hagan Chemicals' Controls, Inc
HCE - Hoffman Combustion Engineering Co
HL - Hall Laboratories
HR - Hewitt-Robins Inc
HT - Hungerford & Terry, Inc
IR - Ingersoll-Rand Co
IW - Illinois Water Treatment Co
JM - Jeffrey Mfg Co
LA - L-A Water Softener Co
LB - Link-Belt Co
LC - The Lummus Co, Heat Exchanger Div
LN - Leeds & Northrup Co
McN - McNally Pittsburg
MR - Milton Roy Co
MS - Maryland Shipbuilding & Drydock Co
PC - Pennsylvania Crusher Co
PD - Prat-Daniel Corp
PM - The Permutit Co, Div Pfaudler Permutit
PP - Pacific Pumps, Inc
RC - Research-Cottrell, Inc
RF - Republic Flow Meters Co
RHE - Ross Heat Exchanger Div
RS - Riley Stoker Corp
SE - Southwestern Engrg Co
STW - Struthers Wells Corp
SW - Shuttleworth Div, Westinghouse Electric Corp
TE - Terry Steam Turbine Co
UC - United Conveyor Co
UCP - United Centrifugal Pumps
UI - Union Iron Works
WC - Water Conditioning, Inc
WE - Westinghouse Electric Corp
WEB - Webster Engineering Co
WI - Wickes Boiler Co
WL - Wellman Conveyors
WM - Whitlock Manufacturing Co
WO - Worthington Corp
WP - Western Precipitation Corp
WS - Warren Pumps Inc

Central-station installations TABLE 2 continued

Project Number	BOILER FEED PUMPS							FUELS							FIRING														
	Capacity each, gpm	Discharge pressure, psig	Manufacturer	Flow control	Drive	Drive hp	Drive manufacturer	Fuel type	Heating value 1000 Btu per lb	Ash fusion temp, F	Fuel delivery method	Coal unloading system	Unloading system mfr	Handling system to storage	Handling system mfr	Coal firing equipment	Firing equipment mfr	No. pulverizers per boiler	Ash-handling system	Ash-handling system mfr	Soot blower type	Soot blowing medium	Soot blower mfr	Dust collector type	Dust collector mfr	Stack height, ft
52	632	2300	AC	Hy	2M	1000	AC	C	13.2	2100	RR	.....	JM	Co	JM	P	CE	3	Pn	UC	Ret	St	CV	El	RC	234
53	1620	2180	PP	R	2M	2500	EL	G,O	1045[10]	.....	Pi,RR	.....	.....	.....	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....
54	2000	1900	PP	.....	3M	1500	WE	C	11.5	2200	Tr	Cl	.....	Co,Sc	McN	Cy	BW	....	Hyd	UC	Ret	Air	DP	None	.....	450
55	668	1870	AC	R	2M	1000	AC	Gas	1090[10]	.....	Pi	.....	.....	.....	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	30
56	640	1680	IR	R	3M	900	AC	C,G	9.2	2100	RR,Pi	CS	LB	Co,Bu,Sc	LB	Cy	BW	....	Hy	UC	Ro,Ret	St	DP	None	.....	188
57	1195	1680	AC	Hy	2M	1500	GE	C	11.5	2100	RR	CS	.....	Co	LB	P	RS	4	Hyd	UC	Ro,Ret	Air	CV	Me	WP	250
								C-s	9.8		Tr	Cn														
58	1650	2030	BP	R	2M	2250	GE	Oil	19.4	2170	RR	Dn	McN	Co	McN	P	BW	6	Pn,Hyd	UC	Ro,Ret	Air	DP	Me	WP	250
								Gas	974		Pi															
59	945	1790	BJ	Hy	2M	1250	GE	C,G	11.6	2200	RR,Pi	CS	AC	Co	.....	P	CE	2	Hyd	.....	.....	St	DP	Me	AT	115
								Oil	18.4		Ba,Tr															
60	1686	3800[12]	WO	Hy	2M	2000	WE	Gas	1000[10]	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
61	300[13]	1800	IR	Hy	2M	1000	WE	Gas	1000[10]	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
62	.....	.....	.....	Hy	2M	.....	.....	C	12.5	.....	.....	.....	.....	.....	.....	P	BW	2	.....	.....	Ret	St	DP	Me	.....	.....
63	1100	1850	IR	R	2M	1500	GE	C	11.5	1900	RR	CS	AC	Co,Bu	WEB	.....	.....	....	Hyd	ASH	Ro,Ret	St	DP	.....	.....	90
64	1100	1850	IR	R	2M	1500	GE	C	11.5	1900	RR	CS	AC	Co,Bu	WEB	.....	.....	....	Hyd	ASH	Ro,Ret	St	DP	.....	.....	90
65	475	1790	IR	Hy	2M	700	WE	An	8.8	2700	Tr	Dump	.....	Co	FE	P	FW	2	Hyd	ASH	Ret	St	CV	Me,El	RC	114
MUNICIPAL FEDERAL AND COOPERATIVE INSTALLATIONS																										
66	2291	2977	PP	Hy	3M	5000	EL	C,G	12.4	2030	Ba,Pi	Cl	DR	Co	LB	Cy	PC	....	Hyd	UC	Ret	Air	DP	El	AT	400
67	2291	2977	PP	Hy	3M	5000	EL	C,G	12.4	2030	Ba,Pi	Cl	DR	Co	LB	Cy	PC	....	Hyd	UC	Ret	Air	DP	El	AT	400
68	2291	2977	PP	Hy	3M	5000	EL	C,G	12.4	2030	Ba,Pi	Cl	DR	Co	LB	Cy	PC	....	Hyd	UC	Ret	Air	DP	El	AT	400
69	1600	2250	BJ	Hy	2M	3000	EE	O,G	18.1	2000	Tr,Pi	.....	.....	.....	.....	.....	.....	....	.....	.....	Ret	St	DP	.....	.....	280
70	1600	2250	BJ	Hy	2M	3000	EE	O,G	18.1	2000	Tr,Pi	.....	.....	.....	.....	.....	.....	....	.....	.....	Ret	St	DP	.....	.....	280
71	.....	.....	.....	Hy	.....	.....	.....	C	11.4	1894	RR	CS	LB	Co	LB	P	CE	4	Hyd	ASH	Ret	St	DP	Me,El	BU	.....
72	1327	2274	WO	R	2M	2250	WE	C	12.4	2150	RR	CS	HR	Co,Bu	WEB	P	RS	4	Pn,Hyd	UC	Ret	St	DP	Me,El	WP	370
73	990	1860	WO	R	2M	1250	WE	Gas	1100[10]	.....	Pi	.....	.....	.....	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....
74	450[13]	1800	PP	Hy	2M	1250	EM	C	10.4	1980	Ba	Cl	WL	Co,Bu	WEB	P	RS	4	Pn,Hyd	ASH	Ret	St	DP	Me	HCC	180
75	600	4840[12]	UCP	R	3M	900	WE	C,G	11.7	1900	RR,Pi	CS	AC	Co	WEB	Cy	BW	.....	Hyd	UC	Ret	Air	DP	Me	WP,PD	200
76	975	2050	IR	R	2M	1500	EL	Gas	1090[10]	.....	Pi	.....	.....	.....	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....
77	1000	1600	IR	Hy	1M	1500	GE	C	11.2	2050	RR	CS	.....	Co	FE	Cy	BW	....	Hyd	.....	Ro,Ret	Air	DP	None	.....	20
78	370[13]	1550	IR	R	3M	1000	GE	C	12.3	2700	Ba,RR	CS,Cl	CIW	Co,Bu,Sc	FE	P	BW	3	Hyd	ASH	Ret	St	DP	Me	PD	150
											Tr															
79	935	1577	PP	R	2M	1000	EL	O,G	18.2	.....	Tr	.....	.....	.....	.....	.....	.....	.....	.....	.....	Ret	St	CV	Me	GF	110
80	260[13]	1575	AC	R	3M	700	AC	Gas	1050[10]	.....	Pi	.....	.....	.....	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....
81	600	1050	.....	R	1M	500	.....	Gas	1025[10]	.....	Pi	.....	.....	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	.....	.....
82	890	1011	BJ	S,Hy	2M	700	EM	C,G	11.0	1950	RR,Pi	CS	HR	Co	FE	P	RS	3	Pn	ASH	Ro,Ret	St	DP	Me	HCC	148
83	450	2760[12]	BJ	.....	2M	400	GE	C	10.6	1900	RR,Tr	CS	.....	Bu,Sc	Ex	Cy	BW	....	Hyd	.....	.....	St	DP	None	.....	.....
84	.....	.....	BJ	S	2M	450	WE	C	12.9	2620	RR	CS	GIW	Co	GIW	.....	DSC	....	Pn	ASH	Sta,Rel	St	DP	Me	WP	75
85	955	1331	BJ	Hy	2M	1250	GE	C,G	11.5	2190	RR	CS,Cl	LB	Bu,Co	LB	Cy	BW	....	Hyd	UC	Ro,Ret	Air	DP	None	.....	175
86	500	1200	PP	.....	2M	350	EM	G	1050[10]	.....	Pi	.....	.....	.....	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....
87	500	1200	PP	.....	2M	350	EM	G	1050[10]	.....	Pi	.....	.....	.....	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....
88	500	1160	WS	R,Hy	1M	500	WE	C	12.2	1950	RR	.....	WEB	Co	WEB	SS	DSC	....	Pn	ASH	Ro,Ret	St	DP	Me	PD	264
89	525	1150	IR	R	2M	450	EL,EM	O,G	18.5	.....	RR,Pi	.....	.....	.....	.....	.....	.....	....	.....	.....	Ro,Ret	.....	DP	.....	.....	165
90	500	1200	PP	.....	2M	350	EM	Gas[14]	1000[10]	.....	.....	.....	.....	.....	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....
91	560	1020	BJ	R	2M	.....	EL	C,G	10.5	2050	RR,Pi	CS	WEB	Co,Bu	WEB	SS	RS	....	Hyd	ASH	Ro,Ret	St	DP	Me	FA	62
92	500	1200	WS	Hy	1M	500	GE	C	12.2	2200	Ba,RR	Cl	.....	Bu	WEB	SS	HCE	....	Hyd	ASH	Ro	St	DP	Me	WP	118
93	325	800	PP	R	2M	200	EL	C,G	9.5	1950	RR,Pi	.....	.....	Co	LB	SS,TG	HCE	....	Pn	Ex	Sta,Rel	St	DP	Me	AB	200
94	250	775	PP	R	2M	200	.....	C,O	11.3	2110	Ba	.....	.....	Co,Bu	.....	SS,TG	DSC	....	Hyd	.....	Ro,Ret	St,Air	CV	Me	AB	150
95	250	775	PP	R	2M	200	.....	C,O	11.3	2110	Ba	.....	.....	Co,Bu	.....	SS,TG	DSC	....	Hyd	.....	Ro,Ret	St,Air	CV	Me	AB	150
96	320	800	AC	R	1M	250	AC	G,O	1100[10]	.....	Pi,Tr	.....	.....	.....	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....
97	...	.....	.....	.....	.....	.....	.....	O,G	18.0	.....	RR	.....	.....	.....	.....	.....	.....	....	.....	.....	Ro	St	DP	None	.....	60

MANUFACTURERS (Continued)

YU - Yuba Heat Transfer Div

SYMBOLS USED ABOVE

Ad - Admiralty
AdI - Admiralty, Inhibited
AlB - Aluminum Brass
An - Anthracite
AsCu - Arsenical Copper
Ba - Barge
Bu - Bulldozer
C - Coal, bituminous
Ch - Coal hauler
CNi - Cupro Nickel
Co - Conveyor
Cr - Crane
CS - Car shaker
C-s - Coal, sub-bituminous
Cl - Coal tower
Cy - Cyclones
De - Demineralizer
Dn - Dump hopper
Dump - Dumper
El - Electrostatic
Ev - Evaporator
Ex - Existing equipment
G - Gas
H - Heater
Hz - Hydrogen
Hot - Condenser hotwell
Hy - Hydraulic coupling
J - Steam jet
Li - Liquid
M - Motor drive
Me - Mechanical
N - None
O - Oil
P - Pulverizer
PAd - Phosphorized Admiralty
Pi - Pipeline
Pn - Pneumatic
R - Regulator
Ret - Retractable
Ro - Rotary pump or blower
RR - Railroad
S - Speed control
SC - Single cylinder
Sc - Scraper
So - Softener
SS - Spreader stoker
St - Steam
Sta - Stationary
TC - Tandem compound
TG - Traveling grate
Th - Track hopper
Tr - Truck
9 - Preferred standard
10 - Btu per cu ft
11 - Low head enclosure
12 - Feet
13 - 1000 lb per hr
14 - Future coal
15 - Includes 20 MW I.C. capacity
16 - Outdoor unit

HEATER					CONDENSER								TURBINES									CONTROLS						
Number	Hi-press heater exit temp, F	Max deaerating press, psia	Manufacturer	Deaeration	Surface, 1000 sq ft	No. water passes	Tube material	Air removal	Manufacturer	Feedwater treatment (raw water)	Feedwater pH	System manufacturer	Number	Capability each, 1000 kw	Turbine type	Manufacturer	Exhaust pressure, psia	No. of bleedpoints	No. main turbine exhausts	Main generator voltage, kv	Generator rating, 1000 kva (mva)	Generator cooling	Combustion control mfr	Feedwater control mfr	Closed-circuit TV mfr	Total boiler capacity incl. new units, 1000 lb per hr	Total generator capability incl. new units, 1000 kw	Project Number
6	500	.....	WE,GR	Hot	45	2	Ad	J	AC	De	....	PM	1[9]	83	TC	GE	0.75	6	2	13.8	96	H_2	BM	BM	GE	2110	208	52
6	481	133	.....	H	.....	...	.....	J	CHW	Ev	....	.....	1[16]	175	TC	GE	0.75	6	3	20	201	Li	.....	.....	None	1250	175	53
6	462	113	WE	H	.....	2	Ad,CNi	J	WE	De	8.1	HT	1[16]	145	TC	WE	0.6	6	2	15.0	160	H_2	BM	BM	DP	.....	.....	54
6	456	85	CFB	H	43	2	Ad	J,Ro	WE	So,Ev	7.0	.....	1[11]	75	TC	AC	0.75	5	1	13.8	96	H_2	BM	BM	None	560	75	55
5	457	.....	WE	H	55	2	Ad	J	WE	De	....	COC	1	82.5	TC	AC	0.75	5	1	13.8	96	H_2	BM,RF	BM	.....	1200	149	56
5	438	60	LC	H	30	1	Adl	J	WE	.....	7.6	MR	1[16]	69	TC	GE	1.3	5	1	14.4	88	H_2	BM	BM	ECA	1000	138	57
4	463	66	GR	H	50	2	Adl	J	IR	De,Ev	7.5	HT	1[9,16]	100	.....	GE	0.75	5	1	13.8	134	H_2	HCC	HCC	GE	1500	200	58
5	470	78	AP,YU	H	35	2	Ad	J	CHW	De	8.0	BI	1	54	TC	WE	0.5	5	1	13.8	64	H_2	BM	BM	.....	795	110	59
5	471	57	GR	H	75	2	PAd	J	AC	So,Ev	7.1	AC	1[9]	113	TC	GE	0.75	5	2	13.8	134	H_2	BM	BM	DuM	800	113	60
5		.....	GR	H	45	2	Ad	J	WO	Ev	....	HL	1[9]	75	SC	GE	1.0	5	1	13.8	96	H_2	.....	HL	None	525	75	61
5	.....	.....	.....	H	.....	...	.....	J	.....	So,Ev	....	.....	1[9]	44	TC	.....	.....	5	1	14	52	H_2	.....	.....	None	1118	132	62
5	420	.....	GR	Hot	35	2	PAd	J	IR	Ev	8.3	GR	1[9,11]	44	TC	WE	0.75	5	2	13.8	.....	H_2	HCC	HCC	.....	450	44	63
5	420	.....	RHE	Hot	35	2	PAd	J	AC	Ev	8.3	GR	1[9,11]	44	SC	GE	0.75	5	2	13.8	.....	H_2	HCC	HCC	.....	900	88	64
5	427	66	WE	H	35	2	Ad	J	WE	So,Ev	10.8	.....	1[9]	44	TC	WE	0.75	5	2	13.8	59	H_2	BM	BM	.....	1050	92.5	65
8	568	74	AP,COC	H	135	2	Ad	J	WO	De	8.7	MR	1	270	TC	WE	0.75	7	3	24	320	H_2	BM	BM	None	2000	270	66
8	568	74	AP,COC	H	135	2	Ad	J	WO	De	8.7	MR	1	270	TC	WE	0.75	7	3	24	320	H_2	BM	BM	None	4000	540	67
8	568	74	AP,COC	H	135	2	Ad	J	WO	De	8.7	MR	1	270	TC	WE	0.75	7	3	24	320	H_2	BM	BM	None	6000	810	68
6	450	35.8	.....	.....	95.0	1	AlB	...	.....	Ev	9.0	.....	1[16]	200	TC	BB	0.75	6	4	18.0	256	Li	.....	.....	.....	1510	200	69
6	450	35.8	.....	.....	95.0	1	AlB	...	.....	Ev	9.0	.....	1[16]	200	TC	BB	0.75	6	4	18.0	256	Li	.....	.....	.....	3020	400	70
...	.....	.....	.....	.....	.....	...	.....	...	.....	.....	....	.....	1	125	TC	GE	0.75	6	...	15	160	H_2	BM	BM	DP	.....	.....	71
6	468	97	WO,YU CFB	H	60	1	Ad	J	WO	De	8.0	COC	1[9]	138	TC	GE	0.75	6	3	15	160	H_2	BM	BM	.....	1200	138	72
5	460	72	COC	H	65	2	Ad	J	WE	De	7.5	IW	1[9]	100	TC	WE	1.0	5	2	13.8	134	H_2	RF	RF	DC	800	100	73
5	449	65	FW,GW COS	H	54	2	Ad	J	COS	So,Ev	9.0	Ex	1	80	TC	WE	1.8	5	1	13.8	96	H_2	RF	RF	None	1584	214	74
5	445	60	WE	H	40	2	PAd	Ro	MS	De	9.0	PM	1	60	TC	WE	0.75	5	1	13.8	60	H_2	BM	BM	None	2325	280	75
5	464	85	CFB	H	65	2	Adl	J	CHW	De	9.0	.....	1[9]	100	TC	WE	1.8	5	1	13.8	100	H_2	LN	RF	.....	2200	280	76
5	405	75	GR	H	.....	2	Ad	...	AC	De	....	.....	1[9]	44	TC	AC	0.5	5	1	13.8	.....	H_2	.....	.....	.....	576	59	77
5	415	68	AC,YU	H	55	2	Ad	J	YU	So,Ev	8.8	BL	1[9]	77	TC	GE	0.75	5	...	13.8	88	H_2	RF	RF	DP	1606	210	78
5	431	68	LA,SE	H	39	2	PAd	J	SE	De,So	....	WC	1[9,16]	44	TC	AC	1.0	5	2	13.8	62.5	H_2	BM	BM	None	425	48	79
5	417	46	AP	H	.....	...	.....	J	.....	Ev	8.8	.....	1[9]	44	TC	AC	0.75	5	1	13.8	58	H_2	RF	RF	.....	758	74	80
2	293	45	.....	H	20	2	Ad	J	WO	.....	....	.....	1[9]	22	SC	WE	1.4	4	1	13.8	23.5	H_2	.....	.....	None	690	70	81
5	414	60	AWS,RHE	H,Hot	27.5	2	Ad	J	CHW	De,So	....	IW	1[9]	33	SC	EL	1.3	5	1	13.8	35.3	H_2	C.V	C.V	None	335	40	82
5	422	.....	WM	.....	27.5	2	.....	J	YU	De	....	.....	1[9]	33	SC	AC	1.8	5	1	13.8	35.3	H_2	MCC	.....	None	1420	113	83
4	401	43	STW	H,Hot	15	2	Ad	J	AC	Ev	7.9	HL	1	16.5	SC	EL	1.2	4	1	13.2	17.6	H_2	BM	HL	None	660	50	84
3	390	76	GR	H	65	2	Ad	J	AC	De,So	8.0	IW	1	100	TC	WE	0.75	5	1	13.8	128	H_2	BM	BM	DP	790	100	85
4	347	50	AWS	H	14	2	Ad	J	EL	De	10.7	.....	1[9]	16.5	SC	EL	0.75	4	1	13.8	22	H_2	BM	BM	None	365	31.5	86
4	347	50	AWS	H	14	2	Ad	J	EL	De	10.7	.....	1[9]	16.5	SC	EL	0.75	4	1	13.8	22	H_2	BM	BM	None	540	49.5	87
4	350	57	WM	H	17	2	Ad	J	AC	Ev	....	.....	1[9]	22	SC	WE	0.75	4	1	13.8	23.5	H_2	BM	BM	None	490	50	88
4	340	67	LC,GW	H	32.5	2	Ad	J	YU	So	9.4	.....	1[9]	25	SC	GE	0.75	4	1	12.5	29.4	H_2	BM	BM	None	680	70	89
4	350	50	.....	.....	15	2	Ad	...	AC	Ev	10.7	.....	1	16.5	.....	AC	0.75	4	1	13.8	17.6	H_2	.....	.....	.....	185	36.5[15]	90
4	349	55	WM	H	18	1	Ad	J	RHE	De	....	.....	1[9]	22	SC	GE	0.75	4	1	13.8	23.5	H_2	RF	RF	None	629	49	91
4	350	20	CH	H	17	2	Ad	J	CHW	Ev	10.6	AC	1[9]	22	SC	GE	0.75	4	1	13.8	23.5	H_2	BM	BM	.....	500	43.5	92
4	352	60	DE	H	13	2	Ad	J	EL	So,Ev	8.5	.....	1[9]	12.7	SC	GE	0.75	5	1	13.8	13.5	Air	RF	C.V	None	360	27	93
2	315	65	RHE	H	10	2	Ad	J	WO	Ev	8.0	.....	1	9.4	SC	EL	0.75	3	1	12.5	12.5	Air	BM	BM	None	150	9.4	94
2	315	65	RHE	H	10	2	Ad	J	WO	Ev	8.0	.....	1	9.4	SC	EL	0.75	3	1	12.5	12.5	Air	BM	BM	None	250	18.8	95
4	372	44	WM	H	13	2	Ad	J	AC	De	....	PM	1[9]	14	SC	AC	0.75	4	1	12.5	15	Air	BM	BM	.....	275	25.5	96
3	350	5	.....	H	11	2	AsCu	J	WE	Ev	....	.....	1[9]	7.5	SC	WE	1.0	3	1	13.8	9.4	Air	.....	.....	.....	410	26.0	97

These footnotes are for Nuclear Survey on following page.

MANUFACTURERS

AC - Allis-Chalmers Mfg Co
ACF - ACF Industries, Inc
AEC - U S Atomic Energy Commission
AECL - Atomic Energy of Canada, Limited
AGC - Aerojet General Corp
AI - Atomics International
Alco - Alco Products, Inc
ANL - Argonne National Laboratory
AOS - A O Smith Corp
APDA - Atomic Power Development Associates, Inc
B&R - Burns & Roe, Inc
B&W - Babcock & Wilcox Co, Inc
Bechtel - Bechtel Corp
CA - Commonwealth Associates
ECNG - East Central Nuclear Group, Inc
FW - Foster Wheeler Corp
FWCNG - Florida West Coast Nuclear Group
GA - Gilbert Associates
GDC - General Dynamics Corp
GE - General Electric Co
GRC - Griscom-Russell Co
HKF - H K Ferguson Co
HTRDA - High Temperature Reactor Development Associates
LASL - Los Alamos Scientific Laboratory
Martin - Martin Co
NRTS - National Reactor Testing Station, Idaho
ORNL - Oak Ridge National Laboratory
PKS - Peter Kiewit Sons, Co
PRDC - Power Reactor Development Co
PS&E - Pioneer Service & Engineering Corp
S&L - Sargent & Lundy
S&W - Stone & Webster Engineering Corp
SS - Stainless steel
Vitro - Vitro Engineering Corp
West - Westinghouse Electric Corp

SYMBOLS

a - Proposed
b - No load
c - Full load
d - Initial
e - Oil-fired superheater supplies 112 mwe of this total
f - Mwt of space heating
g - Approximate
h - AEC Power Demonstration Program
i - Pressure-tube reactor
j - 20 mwt design; 61.7 mwt on test
k - With new core being installed
l - To test nuclear superheating
m - Average
n - Reactor only plus 5-yr fuel charges. Reactor feeds existing turbines
o - Design
p - Based on 50 mwt capacity
q - At 30 mwt
r - Nuclear Power Group paying $15 million for R & D
s - 4.2 mwe from coal-fired superheater
t - Central Utilities Atomic Power Assoc paying $9.6 million for R&D
u - 12 mwe from nuclear superheating
v - Superheating section has 93%-enriched UO_2-SS cermet
w - Guaranteed
x - Expected
y - Ultimate after 4-5 years
z - Mwt for space heating
1 - Blanket of depleted-U pins
2 - APDA paying $14 million for R&D
3 - Blanket: 0.4% enriched U-Mo sodium-bonded in SS tubes
4 - Primary pressure
5 - Secondary pressure
6 - For second core, excluding R&D costs
7 - Excluding R&D costs
8 - Gas turbine components being developed at Fort Belvoir, Va
9 - With cooperation of Hydro-Electric Commission of Ontario and Canadian General Electric Co
10 - Gas flow, 1000 lb per hr

Survey of stationary nuclear power plants

Compiled by: B. G. A. Skrotzki, Associate Editor

Reactor power plant	Owner and operator	Location	Electrical capacity, mwe	Reactor thermal capacity, mwt	Year of first load operation	Reactor fuel	Moderator	Coolant	Coolant temperatures, in and out, F	Coolant pressure, psig	Steam pressure, psig	Steam temperature, F	Steam flow, 1000 lb per hr	Reactor system builder	Architect-engineer	Steam generator manufacturer	Total plant cost, million $	Overall energy cost, mills per kwhr
PRESSURIZED WATER REACTORS																		
Shippingport Atomic Power Station	AEC; Duquesne Light Co	Shippingport, Pa.	66 150[a]	236 520[a]	1957 1960	90% U235 seed Nat UO_2 blanket	Light water	Light water	510 540	1985	870[b] 585[c]	Saturated	861	West	S&W B&R	B&W FW	75.0	64.4
Yankee Atomic Electric Company	Yankee At Elec Co; (AEC Pwr Dem Prog)	Rowe, Mass.	120[d] 185	392[d] 492	1960	3.4% enriched UO_2 pellets	Light water	Light water	487 535	1985	500	470	1800	West	S&W	West	53.1	12 to 14
Indian Point	Consolidated Edison Company of N.Y., Inc	Buchanan, N.Y.	275[e]	585	1961	93% enriched UZr; ThO_2 blanket	Light water	Light water	480 510	1485	355	1000	1900	B&W	Vitro	B&W	100	14.3
Army Package Power Reactor	Army Corps of Engr; Alco Products, Inc	Fort Belvoir, Va.	1.9	10	1957	Highly enriched UO_2-SS plates	Light water	Light water	431 450	1185	407[b] 185[c]	407[c]	34	Alco	S&W	Alco	6.3	.....
Army Package Power Reactor	Army Corps of Engr	Fort Greely, Alaska	1.7 12.3[f]	20	1960	Highly enriched UO_2-SS plates	Light water	Light water	431 450	1185	407[b] 185[c]	407[c]	70	Alco	PKS	Alco	5.4	.....
Modular package power plant	AEC and U.S. Air Force	Sundance, Wyo	1 0.2[g]	8-10[g]	1961	Enriched metallic U	Light water	Light water	.....	.....	.....	Saturated	.....	Martin	.....	.....	5.4	.....
Saxton	General Public Utilities	Saxton, Pa	12	20	1962	3-5% enriched UO_2 pellets	Light water	Light water	505[m]	1185	450[b] 300[c]	Saturated	73	West	GA	.....	6.3[n]	.....
Parr Shoals [i,h]	Carolinas-Virginia Nuclear Power Assoc	Parr Shoals, S.C.	17	60	1962	Slightly enriched UO_2 pellets	Heavy water	Heavy water	550[m]	1485	400	725	203	West	S&W	.....	22	.....
Remote frigid site	Army Corps of Engr	Frigid site	1.5 0.3[f]	10	1960	93.5% enriched UO_2-SS plates	Light water	Light water	522 500	1735	450	Saturated	.....	Alco	.....	Alco	3.2	.....
BOILING WATER REACTORS																		
Experimental Boiling Water Reactor	AEC Argonne National Lab	Lemont, Ill.	5	61.7[j] 100[k]	1956	1.44% enriched U plates	Light water	Light water	479	600	560	Saturated	61[o]	ANL	S&L	.....	4.6[p]	33[p]
Borax-V[l]	AEC Argonne National Lab	NRTS, Idaho	2	20	1960	.....	Light water	Light water	300	419	285	415	.....	ANL	ANL	.....	.....	.....
Vallecitos Boiling Water Reactor	General Electric Co; Pacific Gas & Elec. Co	Vallecitos, Calif.	5	50	1956	90% enriched UO_2-SS plates	Light water	Light water	545	1000	1000	545	90[q]	GE	Bechtel	.....	3.0	.....
Dresden Nuclear Power Station (dual cycle)	Commonwealth Edison Co; NPG[r]	Dresden, Ill.	180	626	1960	1.5% enriched UO_2 pellets	Light water	Light water	547	1000	965[d] 460[s]	541[d]	1400[d] 1200[s]	GE	Bechtel	.....	45.0	9.0 to 7.5[s]
Elk River (closed cycle) [h]	AEC; Elk River Rural Coop Pwr Assoc.	Elk River, Minn.	22[s]	58.2	1961	90-4% enriched UO_2 in ThO_2 pellets	Light water	Light water	538	950	538[d] 506[s]	935[d] 715[s]	258[d] 225[s]	ACF	S&L	.....	11.7	20.7
Pathfinder (nuclear superheat & controlled recirculation) [h]	Northern States Pwr Co.[t]	Sioux Falls, S.D.	62[u]	203	1962	1.8% enriched UO_2 pellets[v]	Light water	Light water	489	600	540	825	615	AG	PS&E	.....	33.1	.....
Humboldt Bay (steam suppression to limit containment)	Pacific Gas and Electric Co.	Humboldt Bay, Calif.	50[w] 60[x]	165[w] 197[x]	1962	2% enriched UO_2 pellets	Light water	Light water	545	1000	545	1000	580	GE	Bechtel	.....	20	8.5
Big Rock Point (forced circulation)	Consumers Power Co.	Big Rock Point, Mich.	50 75[y]	.....	1962	Slightly enriched UO_2 pellets	Light water	Light water	593-	1000-1450	593-	1000-	.....	GE	Bechtel	.....	.....	.....
Argonne Low Power Reactor	AEC; Combustion Engineering, Inc.	NRTS, Idaho	0.2 0.4[z]	3.0	1958	91% enriched UAlNi plates	Light water	Light water	420	300	420	300	9	ANL	.....	.....	.....	.....
FAST BREEDER REACTORS																		
Experimental Breeder Reactor No. 1	AEC; ANL	NRTS, Idaho	0.14	1.4	1951	93% U235 seed Nat U blanket	None	NaK	442 600	15	400	525	3.6	ANL	Austin	ANL	2.7	.....
Experimental Breeder Reactor No. 2	AEC; ANL	NRTS, Idaho	20	62.5	1960	49% enriched U-fission pins[1]	None	Sodium	720 900	100	1250	850	200	ANL	HKF	AOS	29	.....
Enrico Fermi Atomic Power Plant [h]	PRDC; Detroit Edison Company[2]	Lagoona Beach, Mich.	100	300	1960	25.6% enriched U-Mo pins[3]	None	Sodium	800	127	600	740	960	PRDC	CA	GRC	54.6[7]	.....
SODIUM-GRAPHITE REACTORS																		
Sodium Reactor Experiment	AEC; Atomics International	Santa Susana, Calif.	7.5	21	1957	2.8% enriched U slugs	Graphite	Sodium	500 960	0	600	825	60	AI	AI	B&W	8.8	.....
Hallam [h]	AEC; Consumers Pub. Power Dist. of Neb.	Hallam, Neb.	81	254	1961	2.5% enriched U-Mo-SS plates	Graphite	Sodium	500 925	10	800	825	730	AI	Bechtel	GRC	41.3	10 to 11
ORGANIC MODERATED REACTORS																		
Organic Moderated Reactor Experiment	AEC; Atomics International	NRTS, Idaho	0	16	1957	90% enriched U plates	Santowax	Santowax	500 700	300	None	None	None	AI	AI	.....	2.5	.....
Piqua Municipal [h]	AEC and City of Piqua, Ohio	Piqua, Ohio	12.5	46	1962	1.8% enriched U-Mo plates	Terphenyl	Terphenyl	533 617	120	450	550	150	AI	.....	.....	15.3	10 to 11
Burlington Municipal (Fluidized bed)	City of Burlington, Vermont	Burlington, Vt.	50	.....	1967	UO_2 pellets in small beads	Hydro-carbon	Hydro-carbon	.....	.....	.....	.....	.....	West	.....	.....	.....	.....
GAS COOLED REACTORS																		
Gas-cooled reactor experiment[8]	AEC and Aerojet-General Corp	NRTS, Idaho	.....	2	1959	Highly enriched UO_2 plates	Light water	Nitro-gen	1150 out	200+	.....	.....	66[10]	AGC	.....	.....	.....	.....
Gas-cooled reactor	AEC; Kaiser Engrs & ACF Industries Inc.	Oak Ridge, Tenn.	25	.....	1962	Low enriched uranium	Graphite	Helium	.....	.....	.....	.....	.....	ACF	.....	.....	.....	.....
Peach Bottom [h]	Philadelphia Elec. Co., HTRDA	Peach Bottom, Pa.	30 to 40	115	1963	Enr UC_2+ThC_2 in graphite	Graphite	Helium	1380 avg	300	1450	1000	367	GDC	Bechtel	.....	610	.....
ECNG & FWCNG [h,i]	FWCNG & ECNG	West Florida	50	173	1963	Low enriched UO_2	Heavy water	Gas	1050 out	520	1000 1800	1000	.....	.....	.....	.....	25.9	.....
HOMOGENEOUS REACTORS																		
Homogeneous Reactor Experiment – 2	AEC, Oak Ridge National Laboratory	Oak Ridge, Tenn.	0.3	5.2	1957	UO_2SO_4 solution in D_2O	Heavy water	Heavy water	.....	.....	.....	.....	.....	ORNL	.....	.....	.....	.....
Los Alamos Power Reactor Experiment–2	AEC; Los Alamos Scientific Laboratory	Los Alamos, N.M.	0	1.0	1959	Aqueous homogeneous	Light water	Light water	600 out	800	600	492	.....	LASL	.....	.....	.....	.....
Los Alamos Molten Plutonium Reactor Experiment – 1	AEC; Los Alamos Scientific Laboratory	Los Alamos, N.M.	0	1.0	1960	Plutonium	None	Sodium-potassium	600 out	0	600	492	.....	LASL	.....	.....	.....	.....
CANADIAN REACTOR																		
Nuclear Power Demonstration[i]	Atomic Energy of Canada, Ltd[9]	Rolphton, Ontario	20	80	1961	Natural UO_2	Heavy water	Heavy water	485 530	1020	400	Saturated	300	AECL	CGE	.....	.....	.....

For footnotes see preceding page

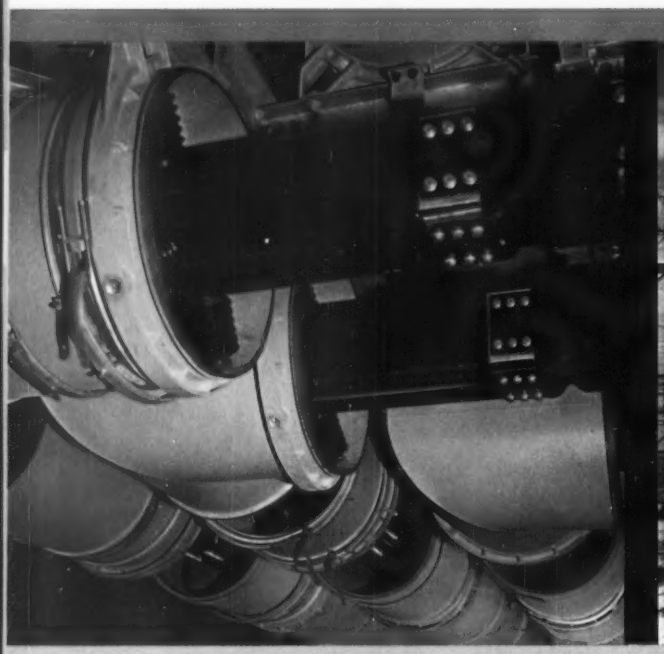
Pacific Gas and Electric Company's Morro Bay Power Station is an outstanding example of clean, modern lines achieved with ribbed walls of Alcoa Aluminum.

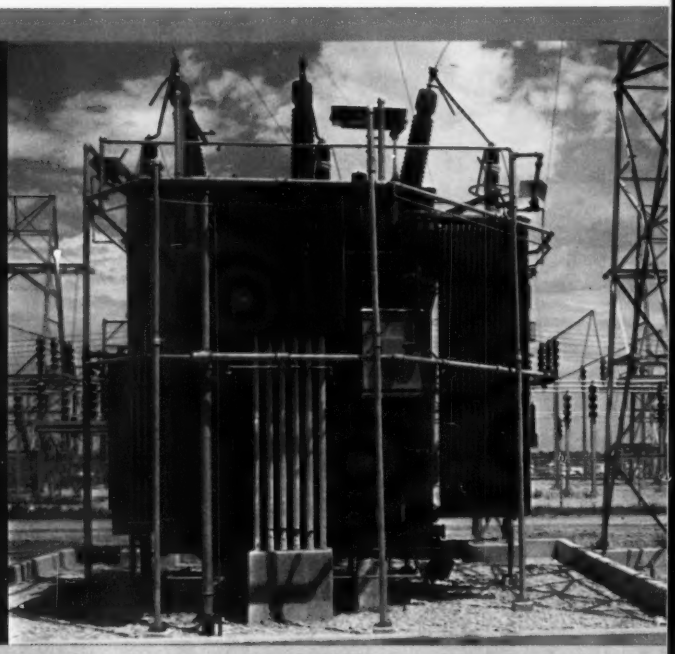
ALCOA RESEARCH

. . . development today for tomorrow's loads

HOW ALCOA ALUMINUM REDUCES COSTS IN GENERATING STATIONS

ALCOA'S THREE-PRONGED ASSAULT ON POWER STATION COSTS



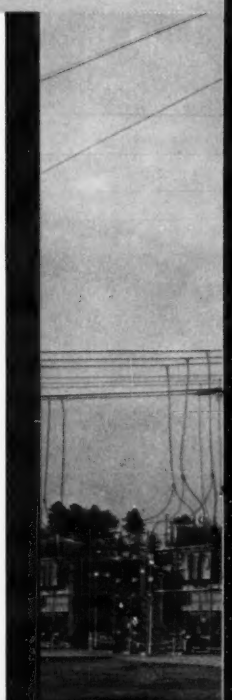


ARCHITECTURAL APPLICATIONS

There are three outstanding reasons why Alcoa Aluminum is the ideal building material for generating stations: low cost, freedom from maintenance and attractive appearance.

Walls of Alcoa Aluminum, uninsulated or sandwich type, go up fast. They require less supporting steel and a lighter foundation. They never need painting. Yet *sandwich wall of Alcoa Aluminum is the lowest cost, insulated metal wall system available.* Savings are also found in roofing, windows, conveyor framing and covers, handrails, grating, tread plate, fencing and many other applications. In every case, strong, lightweight Alcoa Aluminum offers a substantial bonus in corrosion resistance and permanent good looks.

Right: Maintenance-free beauty . . . Duke Power Company's Allen Plant at Belmont, North Carolina.



Through the years, Alcoa has adapted aluminum to new uses in power stations in three areas: electrical, architectural and mechanical. In every case, the objective has been the same: to reduce costs while advancing standards of performance. The result today is virtually an "all-aluminum" power station from conductors to condenser tubes, siding to stair treads. Everywhere you look, aluminum is helping utilities produce more kilowatts per dollar.

ALCOA RESEARCH

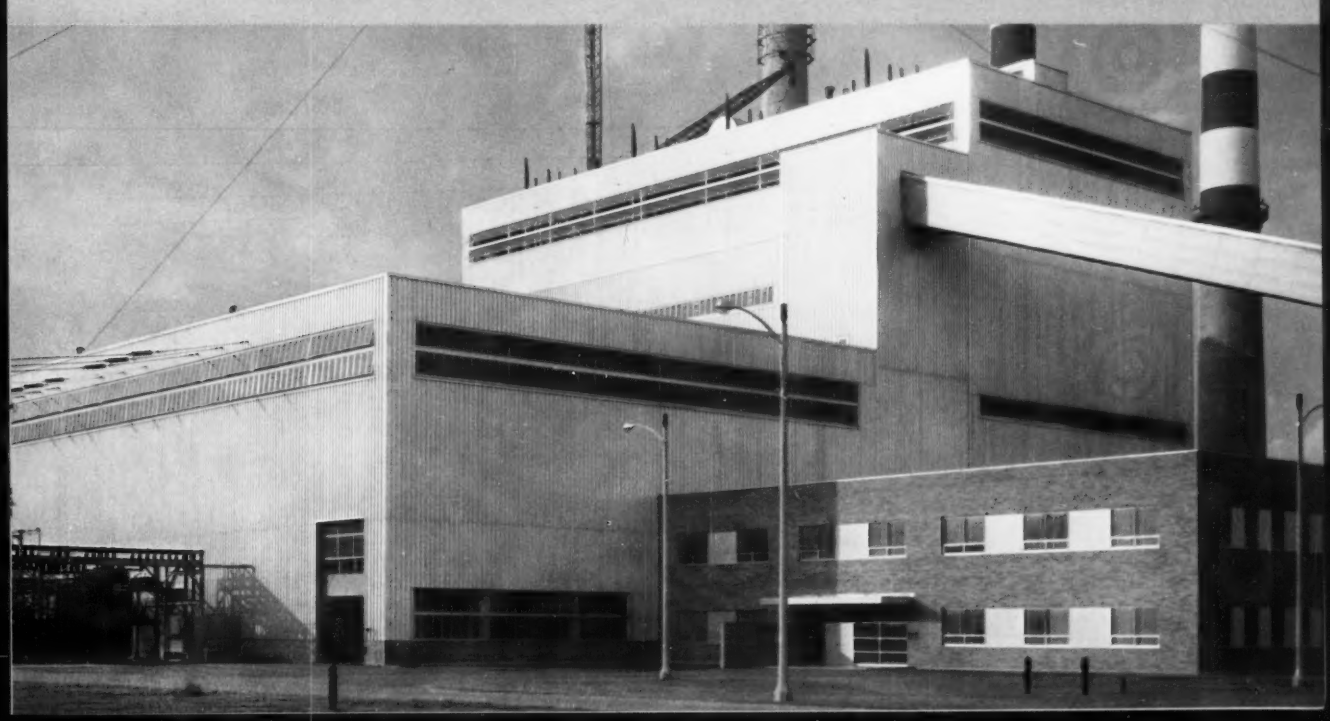
. . . development today for tomorrow's loads

ELECTRICAL APPLICATIONS

The same economy that accounts for almost universal acceptance of aluminum in overhead lines is yours if you specify aluminum for your power station. Alcoa® Bus Conductor, for example, is saving utilities many thousands of dollars, since an equivalent installation costs about one-half as much as copper. Conduit, crossarms and structures, cable, generator field windings, switchgear and isolated phase bus and enclosures, transformer windings and yoke end plates all represent opportunities for savings with Alcoa Aluminum. Soon transformer tanks and radiators will be available in aluminum. All these applications pay major dividends in lower maintenance costs, longer life and higher efficiency.

Left: Alcoa Rigid Conduit is used on this transformer at Kansas City Power & Light Company's Montrose Steam-Electric Generating Station.

Far left: Isolated Phase Bus made by Delta Star Division of H. K. Porter Co., Inc., with Alcoa Integral Web Channel Bus connected with aluminum bolts, aluminum enclosures and cast aluminum support rings at Commonwealth Edison Company's Fisk Station.



MECHANICAL APPLICATIONS

Among the foremost mechanical applications of aluminum are heat exchanger tubes. Low cost, as much as 50 to 60 per cent below other tubes, is combined with long life and superior resistance to carbon dioxide, hydrogen sulfide and ammonia. Moreover, heat transfer characteristics are equal to the best of competitive metals.

Aluminum's resistance to corrosion also accounts for major economies in condensate storage tanks, since no maintenance is required inside or outside and no iron is introduced into boilers.

In numerous applications including control tubing, tanks, covers, boiler lagging, jacketing, panels, canopies and low-pressure feedwater heaters, aluminum can help utilities to save on initial cost, on maintenance, through longer service—or all three.

Condenser tubes of Alcoa Aluminum being installed in an Allis-Chalmers Mfg. Co. surface condenser at The Detroit Edison Company's St. Clair Station.

FREE...

Find out more about the use of aluminum in power stations. *Alcoa Aluminum for Generating Stations* is a new booklet listing many of the latest applications of aluminum in this field—electrical, architectural and mechanical—and containing a complete list of all Alcoa literature available on each of these subjects. It's "must" reading for every cost-conscious utility executive. For your copy, write Aluminum Company of America, 2121-K Alcoa Building, Pittsburgh 19, Pennsylvania.

For more information on *any* application of aluminum in the electrical industry, call Alcoa.

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

ALCOA RESEARCH

. . . development today for tomorrow's loads

BOTH REDUCERS HAVE THE SAME CAPACITY!

This dramatic saving in weight and space is possible only because the reducer on the left has Philadelphia Precision Ground Gearing . . . a new development, so significant you can solve drive problems you could never solve before . . . because you get engineering advantages that have never been available before.

For the first time, standard commercial speed reducers are available with gearing of master gear quality. Extreme accuracy of profiles, profile spacing and surface finish reduce dynamic load factors. Harder gear materials can be used. Result: increased load carrying capacity without sacrificing performance characteristics.

Gear noise is reduced to the point where it is no longer a controlling factor in applications where low sound levels are important.

Backlash is reduced in reversing drives . . . and it is uniform where precision of movement is important.

Vibration is virtually eliminated because tooth to tooth errors, accumulated pitch errors and composite errors are reduced . . . smoother contact results.

Longer gear life. Improved accuracy and better surface finish eliminates "running-in" periods and the resulting wear on gearing.

If you have a new product on the boards . . . design changes coming up . . . or new drive requirements of any kind, Philadelphia Precision Gear Drives may give you the competitive edge you've been looking for. Write for full data on precision ground gearing in spiral bevel, parallel shaft and In-Line reducers as well as gearmotors and Motoreducers. If you have a special drive problem, the full facilities of our engineering staff are available to help you find the solution.

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INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID MIXERS • FLEXIBLE COUPLINGS

R/M POLY-V® DRIVE MEETS HEAVIEST LOAD REQUIREMENTS

Poly-V®
Drive Specifications
for 2500 Ton
Erie Forging Press:

Poly-V* Belt "M":
301″ P.L. x 9″ wide,
24 ribs.
Driver Sheave: 17″
P.D. 68″ Diameter
Flywheel.
100 Horsepower.

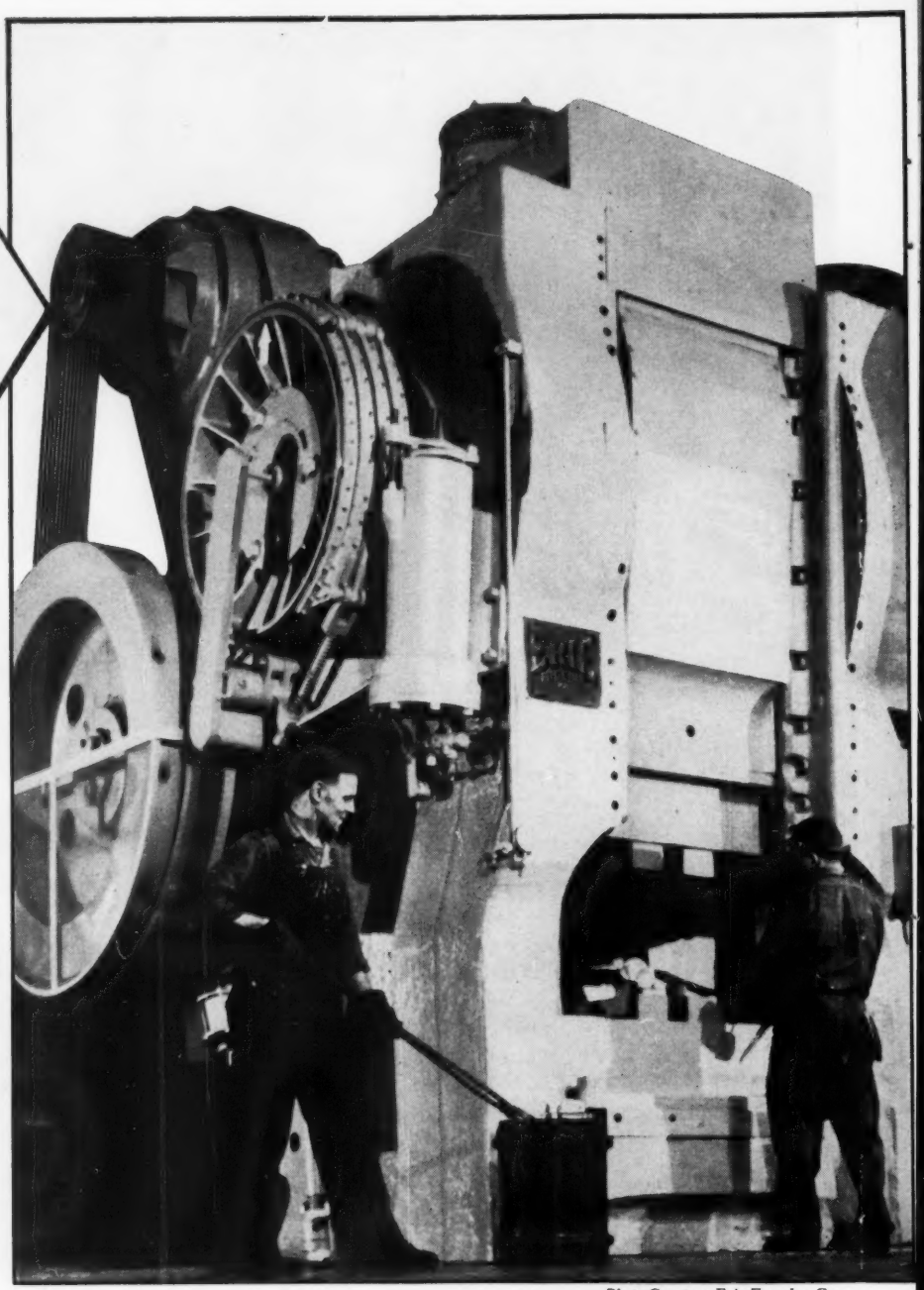
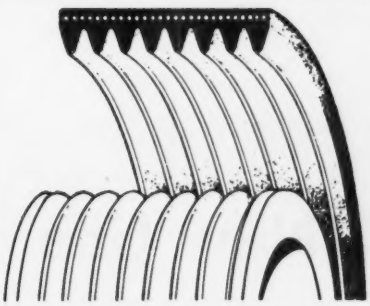


Photo Courtesy Erie Foundry Co.

R/M POLY-V* DRIVE...MORE USE PER DOLLAR

Compact Poly-V Drive delivers power to spare for this huge 2500 ton forging press, newly introduced to industry by Erie Foundry Company. R/M's patented drive design provides the higher horsepower capacity . . . more power per inch of drive width than ever before possible! Because it employs a single, endless V-ribbed belt running on sheaves specially designed to mate precisely with the belt ribs, Poly-V delivers up to 50% more power than ordinary V-drives of equal width . . . or equal power in as little as ⅔ the width. Poly-V Drives have narrower sheaves . . . less shaft overhang . . . less drive weight to meet *every* heavy duty application.

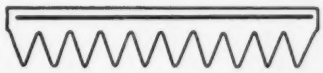
Poly-V's single unit belt design eliminates multiple-belt "length matching" problems, too. Belt speed ratio and belt position remain constant from no load to full load . . . assure smoother, cooler running—less wear on belts *and* sheaves! Just two belt cross sections meet every heavy duty drive requirement. Ask an R/M representative to help determine the R/M Poly-V* Drive specifications for your power driven equipment. Or write for Bulletin #M141.



- **ELIMINATES "MATCHING" PROBLEMS**

A SINGLE UNIT across full width of sheave—NOT an assembly of SEVERAL V-BELTS

Poly-V



V-Belts

- **MORE UNIFORM POWER**
- **IN LESS SPACE**

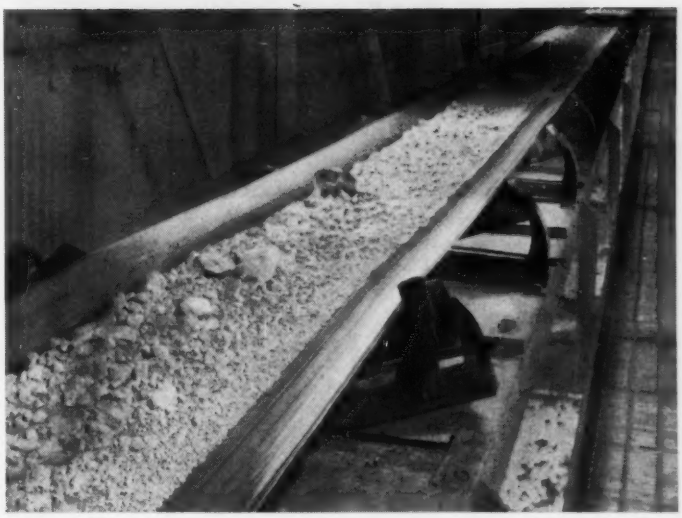
Uninterrupted strength member full width of sheave provides higher horsepower capacity with less stretch —in less space.

- **MAINTAINS GROOVE SHAPE**
- **COMPLETE CONTACT-PRESSURE**
- **MORE CONSTANT SPEED RATIO**

Sheave grooves do not wear out of shape. Full and complete contact-pressure of rubber-to-sheave maintains groove profile. Maintains constant pitch and speed ratio.

..."MORE USE PER DOLLAR"

*Poly-V is a registered Raybestos-Manhattan trademark.



R/M CONVEYOR BELTS FOR LONGER SERVICE

Extra flexible Ray-Man trains naturally, troughs easily... handles fuller, *heavier* loads even where narrow belts and small pulleys are required. Holds fasteners under severe conditions of use, requires no breaker strip. For severe shock loading, R/M makes extra-cushioned Homocord... and R/M Tension-Master for extra long lifts, high tensions. Exclusive "XDC" Cover protects R/M heavy duty belts against wear, tear, cuts and abrasions. Write for Bulletin #M302.

ALLFLEX HOSE IS STRONG *AND* FLEXIBLE

Exclusive engineered advantages of Allflex hose add up to easier handling, longer life... lower hose costs for a variety of uses. This versatile, all-purpose construction has no pre-set twist... coils and uncoils freely in *any* direction. Uniform inside and outside diameters assure safer, easier coupling. One of a complete line of quality R/M hose constructions for general and special purpose use... engineered for "More Use per Dollar" on every job! Write for Bulletin #7075.

RM 917-A

BELTS • HOSE • ROLL COVERINGS • TANK LININGS • INDUSTRIAL RUBBER SPECIALTIES

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

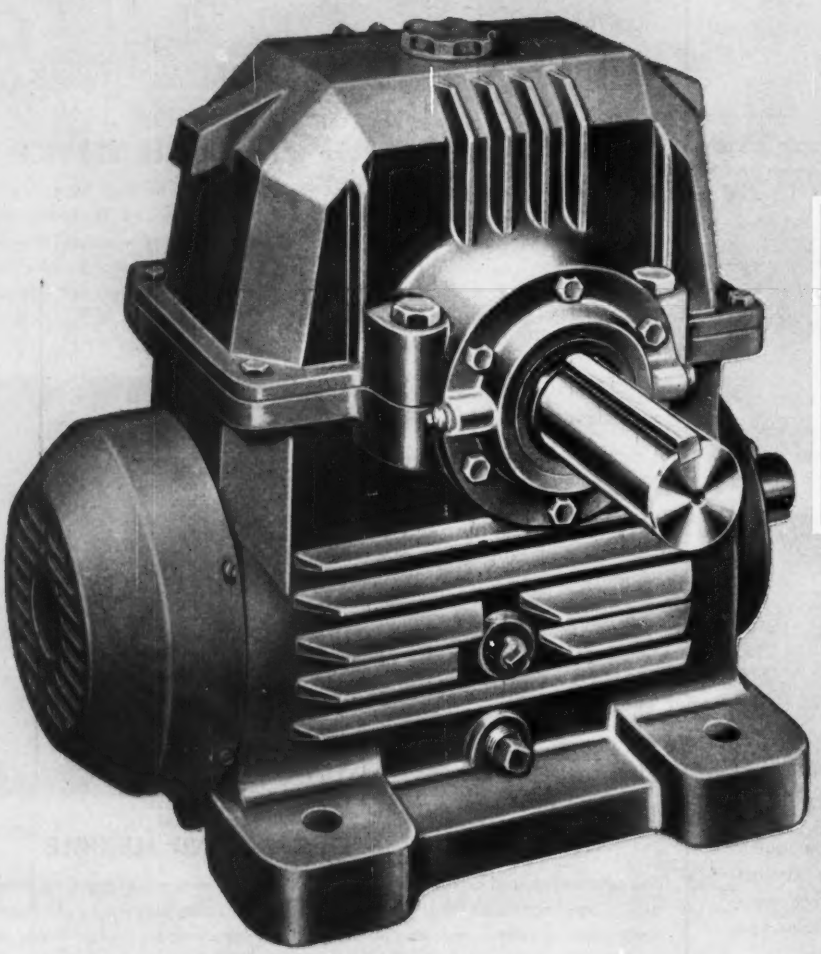
RAYBESTOS-MANHATTAN, INC.

Other R/M products: Abrasive and Diamond Wheels • Brake Blocks and Linings • Clutch Facings • Asbestos Textiles • Mechanical Packings • Engineered Plastics • Sintered Metal Products • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

For more facts circle 861 on Reader Service card, p 227

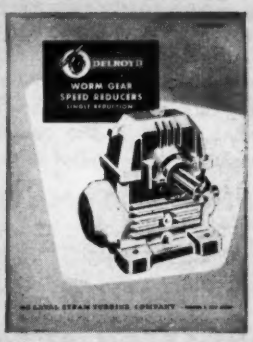
DELROYD
SPEED REDUCERS

DE LAVAL Announces All New Line of Single Reduction Speed Reducers



DELROYD
TYPE B
fan cooled
5" through 12"
center
distance
★

Send for this new 32-page Bulletin 3805 today.



New Delroyd single reduction speed reducers are available in a wide range of sizes and horsepower ratings. These worm gear units include centrifugally cast gears and fan cooling, and carry *the new AGMA ratings.*

DE LAVAL *Steam Turbine Company*

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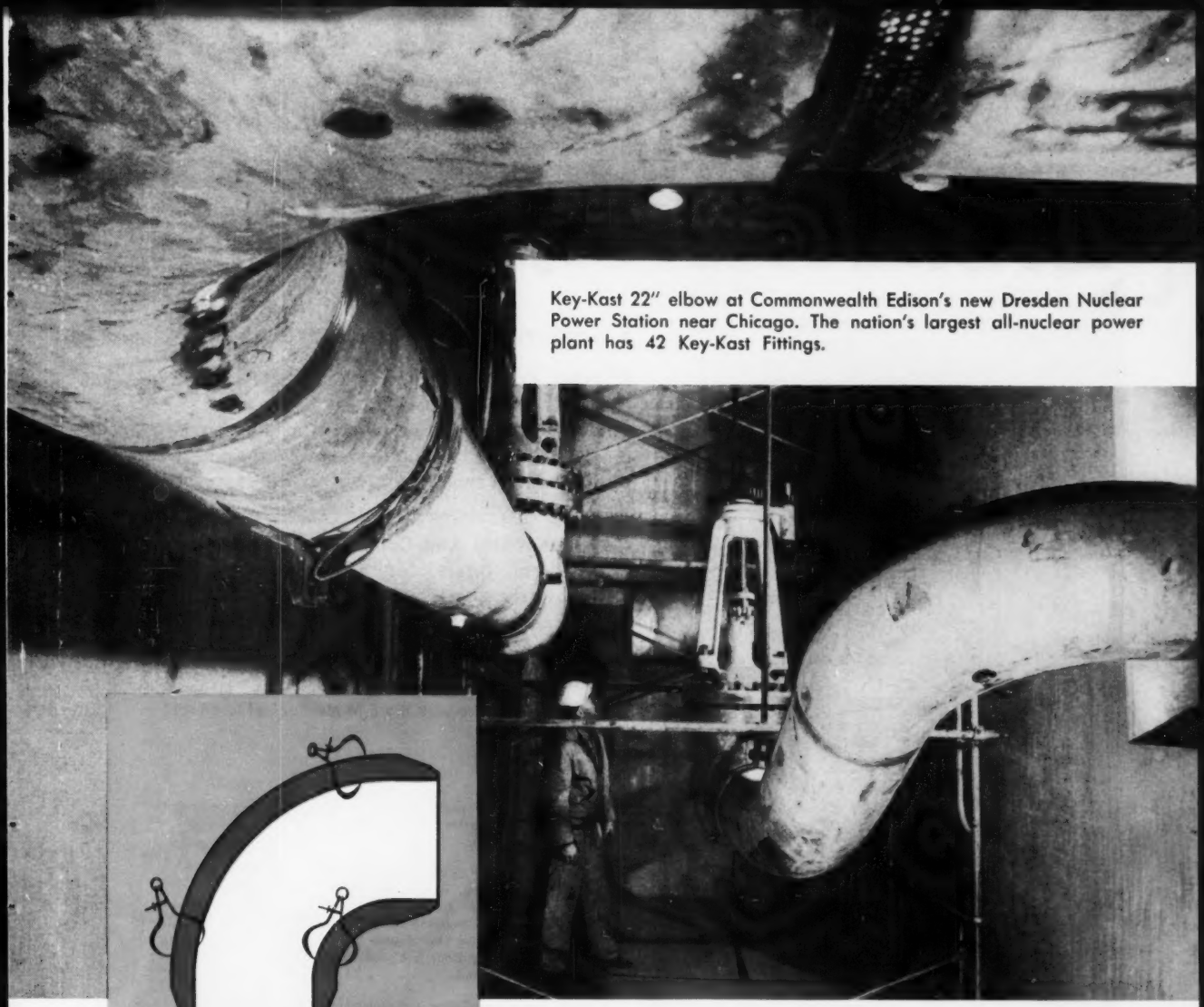
DL 479



Key-Kast 22" elbow at Commonwealth Edison's new Dresden Nuclear Power Station near Chicago. The nation's largest all-nuclear power plant has 42 Key-Kast Fittings.

Uniform Wall Elbows

Key-Kast Elbows have uniform cast steel walls approximately 15% heavier than the required minimum thickness of pipe walls of the same I.D. For extra highly stressed line sections, the wall thickness can be increased as much as desired — without sacrificing uniformity.

The flexibility of Key-Kast Elbows permits their use in piping systems based on the usual piping stress calculations. Write for engineering bulletin entitled "Key-Kast Welding Elbows in Piping Stress Calculations" and for W-K-M's Quality Control Specifications No. 103058 for nuclear power.

Products of W-K-M's
Creative Engineering

KEY-KAST® elbows will carry steam at big nuclear installation

KEY-KAST *Uniform Wall* Austenitic Steel Elbows are the *first* cast welding fittings to be used in an all-nuclear power plant.

Quality controlled through the most rigid metallurgical production and testing standards, Key-Kast Fittings meet ASTM specifications, and ASME and ASA code requirements.

Call your Key-Kast representative for prompt, experienced service in selecting the Key-Kast Fittings best suited to your job. Available in all standard shapes, sizes and schedules . . . or specially designed to meet specific conditions of pressure, temperature and lading. *W-K-M Division of ACF Industries, Incorporated, P. O. Box 2117, Houston, Texas.*

Key-Kast Fittings can handle **any** piping job. Specify them. You'll get outstanding service.

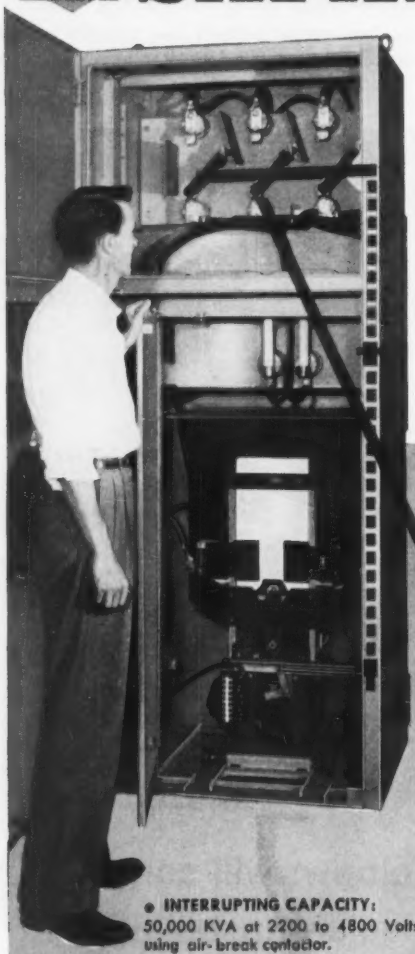
W-K-M
SERVING INDUSTRY 40 YEARS

5904

For those who think twice about

TWO E-M MOTOR CONTROL LINES

E-M SAFAIR Magnetic Control (NEMA CLASS E-1)

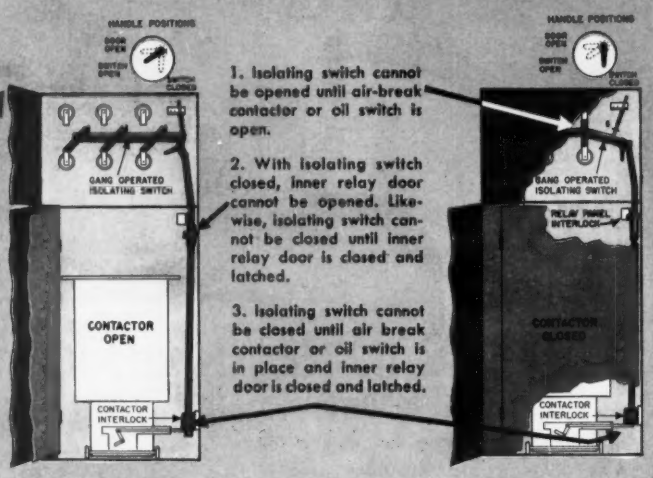


● **INTERRUPTING CAPACITY:** 50,000 KVA at 2200 to 4800 Volts, using air-break contactor.

Compare these features with those of your present controls

1. **Complete Personnel Safety** with a foolproof system of mechanical interlocking between gang-operated isolating switch, oil switch or air-break contactor, and compartment doors.
2. **Complete Motor And Control Protection.** Skillfully engineered and applied components are carefully coordinated to protect both motor and control over complete design range of overload and fault conditions.

You can't make a mistake with the E-M Mechanical Interlock!

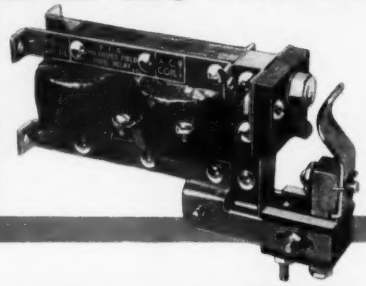


1. Isolating switch cannot be opened until air-break contactor or oil switch is open.
2. With isolating switch closed, inner relay door cannot be opened. Likewise, isolating switch cannot be closed until inner relay door is closed and latched.
3. Isolating switch cannot be closed until air break contactor or oil switch is in place and inner relay door is closed and latched.

E-M SAFETY-GANG ISOLATING SWITCH of SAFAIR Control is externally operated, internally interlocked as detailed in color and diagrams above, right.

SAFAIR features a 50,000 kva (NEMA Class E-1 maximum rating) air-break contactor suitable for repetitive motor starting and rapid switching in a complete line of squirrel-cage and wound-rotor induction motor controls and synchronous motor controls.

PFR* for Simple, Reliable SYNCHRONOUS MOTOR CONTROL



Safair- and Safuse-controlled synchronous motors pull into step smoothly and powerfully every time. E-M-invented *Polarized Field Frequency Relay system of synchronous motor

3300-TPA-2189

ELECTRIC MACHINERY

Originators of the safety-gang

their men and motors . . .

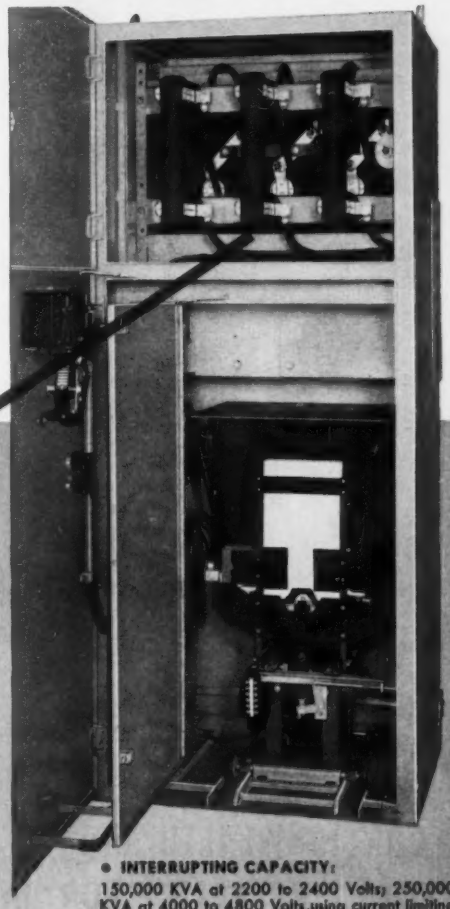
OFFER COMPLETE PROTECTION!

E-M SAFUSE Magnetic Control (NEMA CLASS E-2)

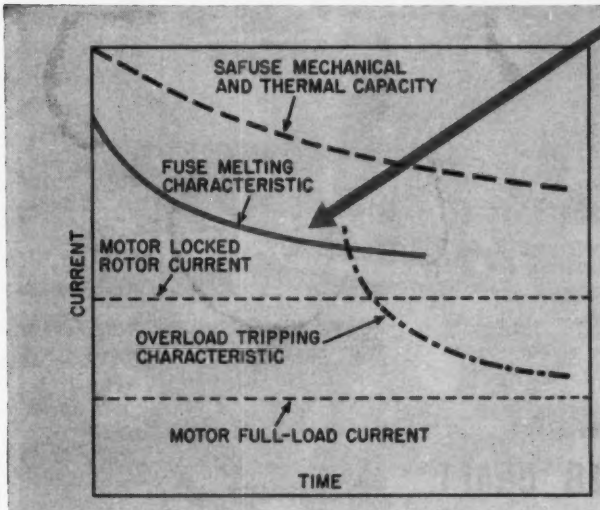
❸ **Complete Front Accessibility.** Controls may be placed in rows, back-to-back or back-to-wall—no access required to back or sides.

❹ **Complete Space Utilization.** Imaginative E-M engineering has provided a highly compact control design without compromise on safety or performance, and with provision to accommodate modifications.

❺ **Complete Modification Line.** You can tailor the control to fit your exacting requirements—nearly 100 options and special features available.



• **INTERRUPTING CAPACITY:** 150,000 KVA at 2200 to 2400 Volts; 250,000 KVA at 4000 to 4800 Volts, using current limiting fuses with air-break contactor or oil switch.



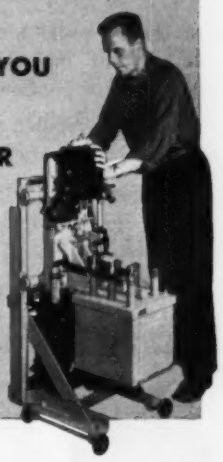
starting and synchronizing is sensitive to the electrical condition of the field winding, applying field excitation at proper rotor angle for maximum synchronizing torque with minimum current inrush . . . and it's coupled with E-M's modern field failure protective system.

FAST ACTING FUSES *plus* E-M Safety-Gang Isolating Switch in SAFUSE are the best possible combination for complete motor and control protection thru NEMA Class E-2 maximum ratings. The current limiting fuses provide short circuit protection and are carefully coordinated with overload relays as shown in diagram above.

Complete information and helpful application data are available from your E-M Field Engineer. Call him and write the factory for publications 242A and 249.

SAFUSE GIVES YOU CHOICE OF AIR-BREAK CONTACTOR OR OIL SWITCH

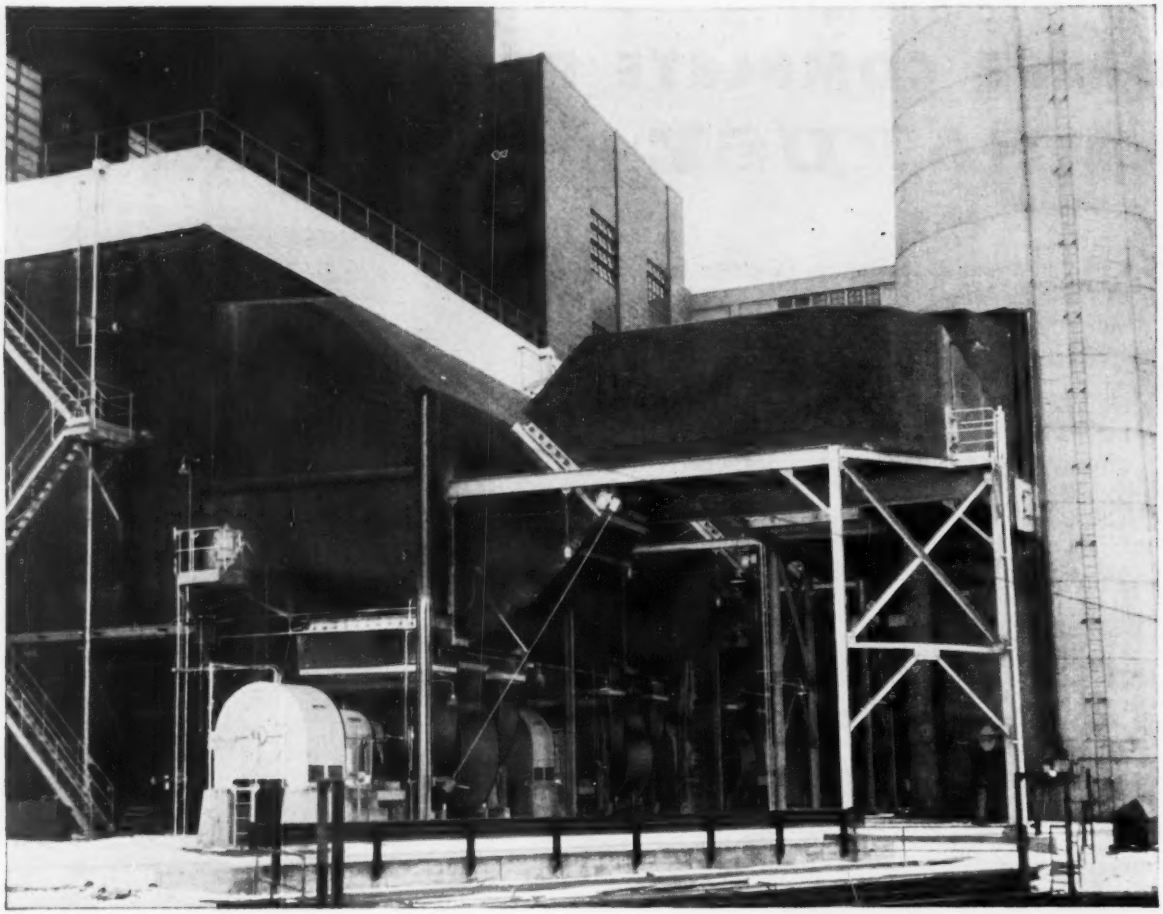
For highly repetitive duty use the roll-out air break contactor. But for less frequent starting—or in areas of severe dust, dirt, moisture, or corrosive fumes—the roll-out oil switch is recommended.



MFG. COMPANY MINNEAPOLIS 13, MINNESOTA

disconnect high-voltage fused control

For more facts circle 864 on Reader Service card, p 227



"Buffalo" Induced Draft Fans at Commonwealth Edison Company's Waukegan Station, Unit 7. Fans draw from a common precipitator plenum chamber and discharge into a common stack. Fans deliver 312,000 cfm at 21" S.P. at 300° F., have air cooled bearings. Engineered by Sargent and Lundy.

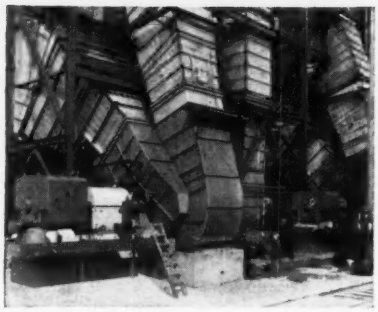
COMMONWEALTH EDISON COMPANY SELECTS "BUFFALO" FOR INDUCED DRAFT

The Commonwealth Edison Company has, over the years, purchased numerous "Buffalo" fans. This is a tribute to the performance, quality and long service life of "Buffalo" Products.

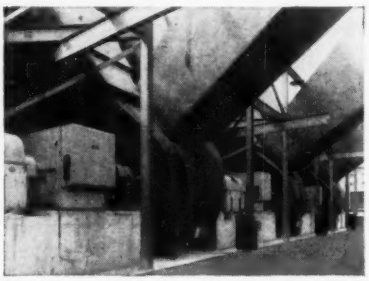
This same reliable performance and "Q" Factor Quality Construction is available to you in every "Buffalo" fan.

You are assured of getting the right fan for every job, too, since "Buffalo" offers a complete line of fan wheel types, each suited to a different set of circumstances.

The next time you need fans for any installation, large or small, be sure to phone your "Buffalo" Engineering Representative. He will have the best fan for the job and the experience necessary to see that it is recommended.



Installation photo, Commonwealth Edison Company's Will County Station Unit 3. This is one of four I. D. Fans now operating at 237,500 cfm at 15" S. P., 300° F. Engineered by Stone and Webster Engineering Corp.

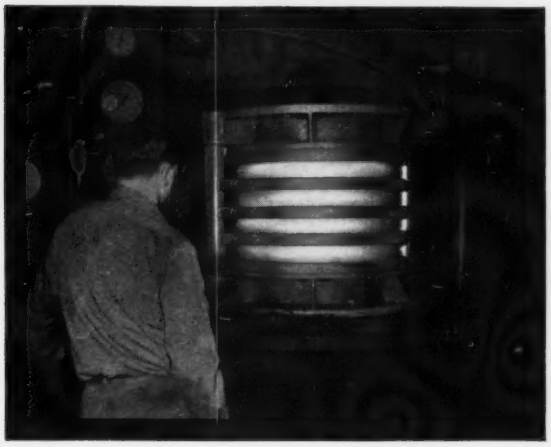


Construction photo showing three of the four "Buffalo" I. D. fans at Commonwealth Edison Company's Fisk Street Station. These fans are now each operating at 362,300 cfm at 23.2" S.P., 325° F. Engineered by Bechtel Corp.

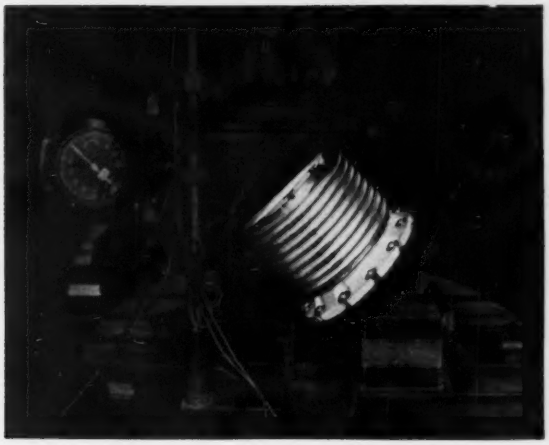
BUFFALO FORGE COMPANY
Buffalo, N. Y.
Buffalo Pumps Division Buffalo, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING
FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

4 WAYS to get maximum reliability in expansion joints



1 Insist that the corrugated bellows be hydraulically formed. The reason is simple. Whenever bellows are formed by circumferential welding . . . whether by edge, seam or fillet welding . . . they will always be subject to premature failure because of stress concentrations at the welds.



2 Be sure the manufacturer maintains a continuous and comprehensive program of endurance testing. This is basic, because of the many variables that affect expansion joint life. Accurate determination of expansion joint life expectancy can only be determined by cycling to destruction.

3 Demand proof that the manufacturer can produce longitudinal welds in the corrugated bellows having the same strength, physical properties and thickness as the parent metal . . without grinding. A weld that is hard to find is a ground weld. Variations in weld thickness set up points of stress concentration . . . opening the way for premature failure.

4 Check the ability of the manufacturer to supply a team of *competent* design and application specialists to work with your engineers. Check their specific experience in handling critical, complex applications in your field . . . complete to the record of successes or failures behind them, and details of how this experience will be brought to bear on your problem.

At Zallea, none of the many factors affecting expansion joint reliability are left to guesswork . . . including the four vital ones above.

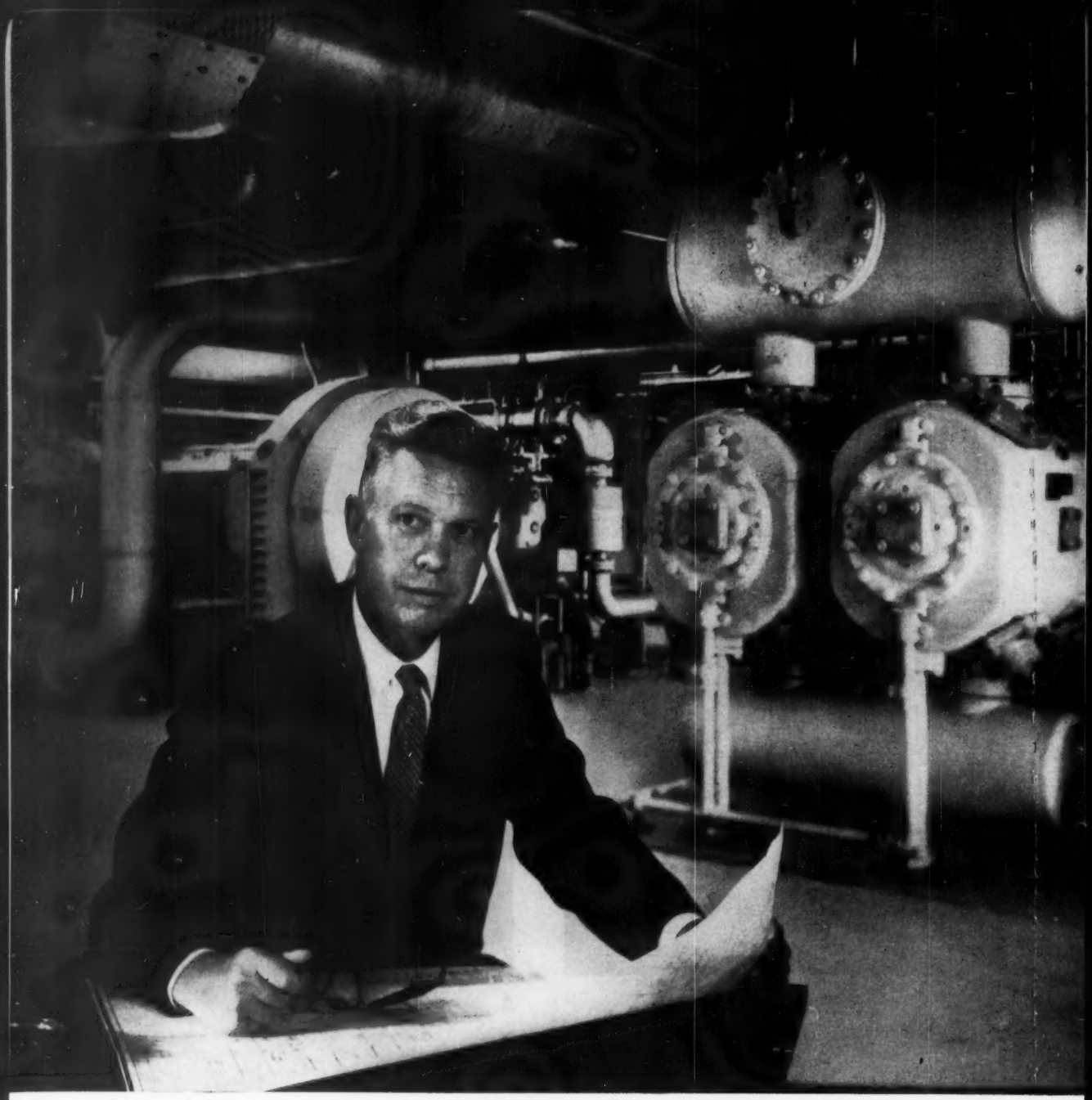
This is reflected in these facts. Zallea material specifications are the most exacting in the industry. Zallea expansion joints are hydraulically formed. Zallea advanced welding techniques insure welds having the same thickness, strength and physical properties as the parent metal. Zallea has done more cyclic testing to destruction than all government agencies and industrial firms combined. Zallea has produced more expansion joints than any other manufacturer . . . offers more application engineering experience.

For all the facts, write for Catalog 56. Zallea Brothers, Taylor and Locust Streets, Wilmington 99, Delaware.

Zallea for maximum reliability

ZALLEA BROTHERS, Wilmington 99, Delaware • World's largest manufacturer of expansion joints

For more facts circle 866 on Reader Service card, p 227



Background photo shows Cooper-Bessemer FM compressors for soot blowing service in a large western utility.

ECONOMICS OF BOILER CLEANING WITH COMPRESSED AIR (Versus Steam)

1. Pressure is always adequate to do clean, thorough job.
2. Better programming with air . . . gets better cleaning results for higher boiler efficiency.
3. Lower cost for blowing medium . . . less waste.
4. No quenching action on hot alloy tubes or pressure vessels.
5. Much less maintenance of blower equipment due to erosion, corrosion, packing wear.
6. Improved housekeeping . . . no steam or condensate leakage.
7. Greater over-all economy of blowing medium on evaluated basis.
8. Eliminates condensate makeup required when blowing with steam.

For more facts circle 867 on Reader Service card, p 227

Soot blowing with air is faster, cleaner, less costly

...a report on soot-blowing applications by L. B. Schueler, *Power Plant Consulting Engineer, The Cooper-Bessemer Corporation*

The big reason why power companies and their consultants are switching from steam to air for soot blowing is *to reduce costs.* Compressed air does the job more thoroughly, uniformly, with less mess and at less cost. Its high efficiency increases the capacity, availability and economy of the entire furnace and boiler! Total maintenance cost is very much lower.

The whole story is given in the reprint of an article, "Steam or Air: Which costs more for boiler cleaning?" Write for your free copy. We will gladly work with you on your plans for compressor facilities for soot blowing . . . or other power plant needs. Call the nearest office.

BRANCH OFFICES: Grove City • New York • Washington • Gloucester • Pittsburgh Chicago • Minneapolis • St. Louis • Kansas City • Tulsa • New Orleans • Shreveport • Houston Greggton • Dallas • Odessa • Pampa • Casper • Seattle • San Francisco • Los Angeles

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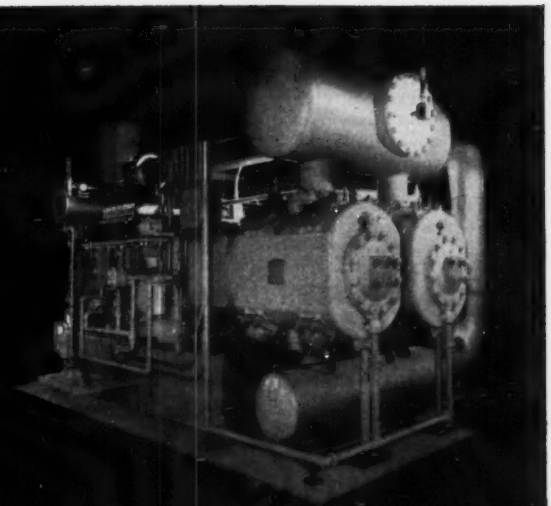
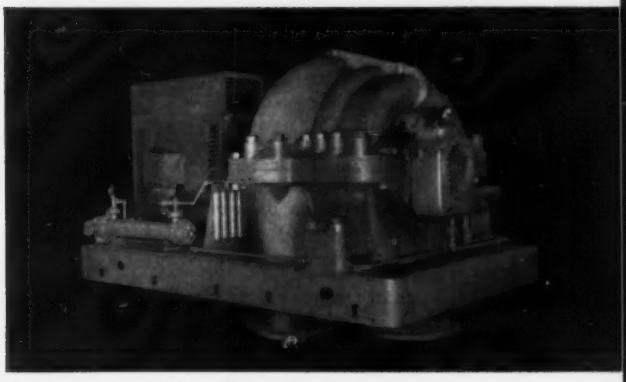
Cooper Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES: GAS • DIESEL • GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL, ENGINE, TURBINE OR MOTOR DRIVEN





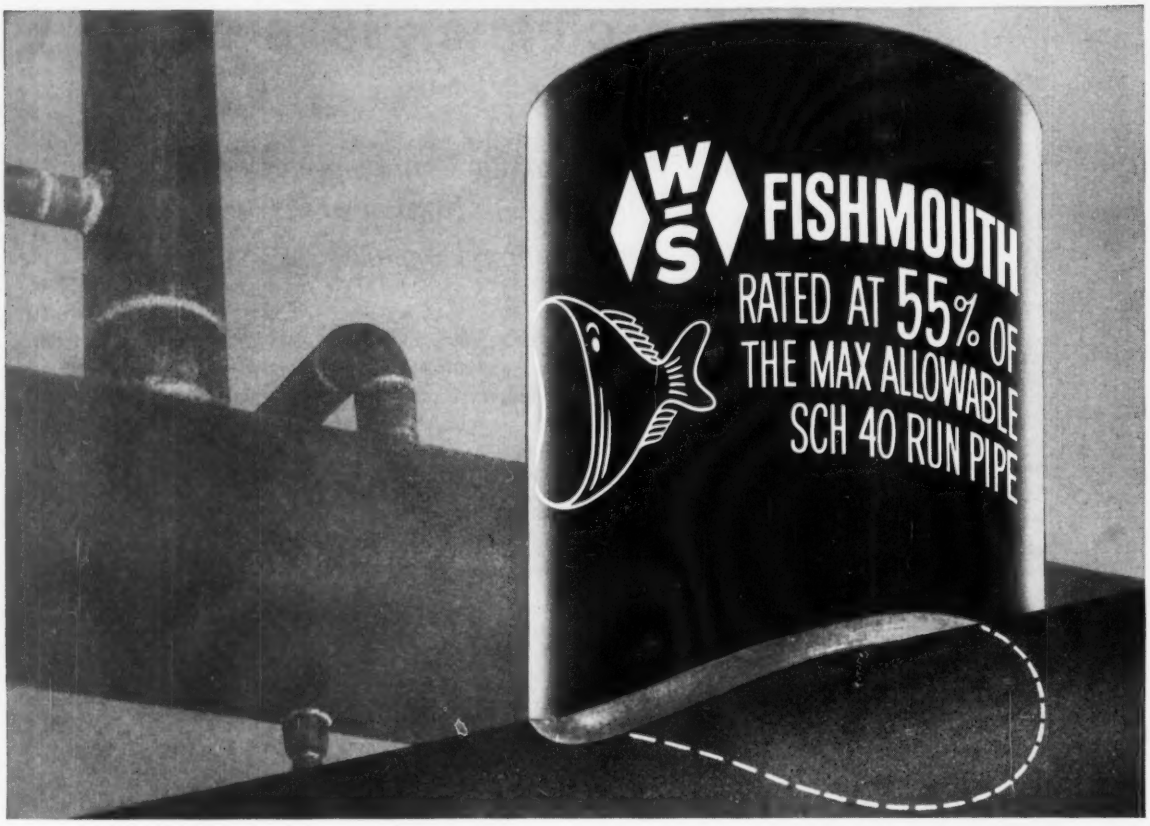
Multi-stage centrifugal compressor. Available from 7000 cfm and up.

◀ *Multi-stage reciprocating compressor. Available up to 30,000 cfm free air.*

FOR BRANCH CONNECTIONS 2 INCHES OR OVER:

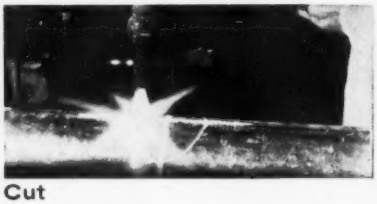
Now! Only 81¢ for a 2″ branch fitting!

THAT'S ALL A NEW, READY-MADE W-S FISHMOUTH COSTS

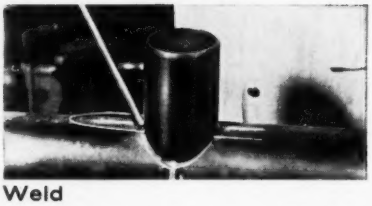


IT'S THE MOST PRACTICAL WAY TO MAKE A BRANCH CONNECTION

Mark



Cut



Weld

The W-S FISHMOUTH saves 50 per cent or more over commercially available branch fittings . . . *costs even less than your own field- or shop-made connection.* Made from Schedule 40 pipe, W-S FISHMOUTH is fully machined and perfectly shaped for strong, leak-proof joints. A ready-made W-S FISHMOUTH is rated for working pressures to 55 per cent of maximum run-pipe limits. Sizes: 2″ to 12″ IPS, butt weld ends. Fewer sizes handle many more jobs, eliminate need for special fittings.

No time or cost required to shape, fit or bevel. Ideal for close-quarter work. Easy access to inspect weld penetration or to back-weld. W-S factory machining means a secure, permanent installation every time.

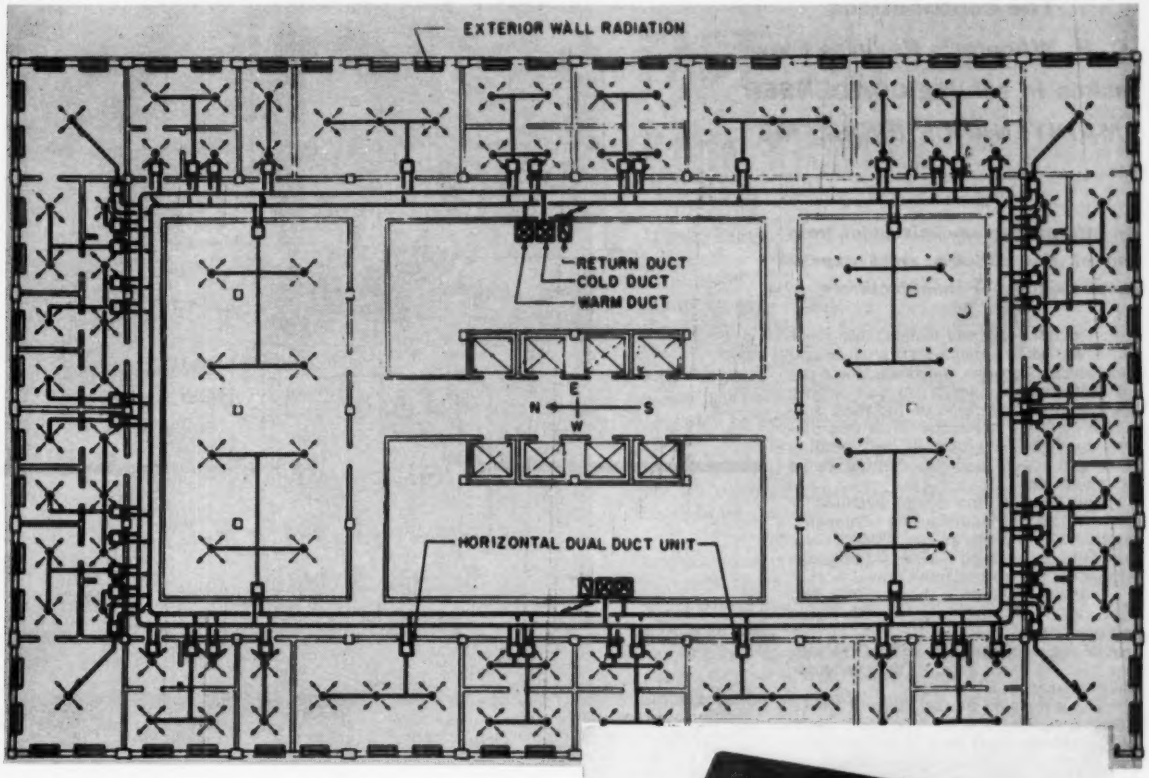
Ready-made, the W-S FISHMOUTH costs less to buy and install than anything you can buy or make. Write, today, for complete information, prices and names of distributors to: *Forge and Fittings Division, H. K. Porter Company, Inc., Box 95, Roselle, N. J.*

FORGE AND FITTINGS DIVISION **PORTER** **H.K.PORTER COMPANY, INC.**

PORTER SERVES INDUSTRY: with Rubber and Friction Products—THERMOID DIVISION; Electrical Equipment—DELTA-STAR ELECTRIC DIVISION, NATIONAL ELECTRIC DIVISION; Specialty Alloys—RIVERSIDE-ALLOY METAL DIVISION; Refractories—REFRACTORIES DIVISION; Electric Furnace Steel—CONNORS STEEL DIVISION, VULCAN-KIDD STEEL DIVISION; Fabricated Products—DISSTON DIVISION, FORGE AND FITTINGS DIVISION, LESCHEN WIRE ROPE DIVISION, MOULDINGS DIVISION, H. K. PORTER COMPANY de MEXICO, S. A.; and in Canada, Refractories, "Disston" Tools, "Federal" Wires and Cables, "Nepcoduct" Systems—H. K. PORTER COMPANY (CANADA) LTD.

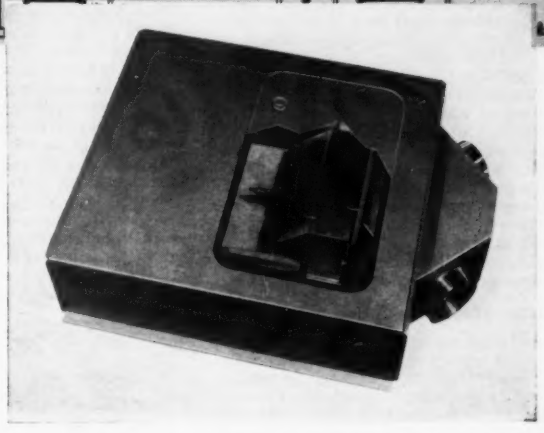
For more facts circle 868 on Reader Service card, p 227

NO BALANCING BOTTLENECK WITH BUENSOD



Shown above is a typical office building Dual Duct layout with individual overhead mixing units in each zone for selective temperature control. Radiation at the exterior walls prevents undesirable down drafts in cold climates and provides heat during night and weekend operation (existing buildings with radiation systems are usually treated in this manner). Changes in mixing units and zone arrangements may readily be made without disturbing the main system. When equipped with pre-set volume regulators, no balancing of units is required on the job site.

Illustrated: Buensod Type H unit designed for overhead installation, generally above hung ceilings. The unit discharges quietly and may be connected to any standard diffuser or grille. Cutaway shows self-contained volume regulator in place.



Tedious, on-the-job adjustment of volume used to be a major bottleneck in the installation of Dual Duct high velocity air systems. Now Buensod air mixing units with Automatic Volume Regulators eliminate that bottleneck. Units are balanced at the factory to specifications. Upon installation they will deliver the pre-determined air volume ±5%. For renovations of existing buildings, this feature permits zones to become operative upon installation of units. There is no need to wait until the entire job is complete.

A simple, tent-shaped apparatus is the heart of this Buensod unit. It automatically maintains constant air quantity, regardless of static pressure variance on mixing valve inlet or outlet. The volume control is completely independent of any sensing instrument, complicated linkage arrangement or outside power source.

Plan on Buensod for your next project.

BUENSOD DUAL-DUCT

Write for details to: BUENSOD-STACEY INC.

Buensod-Stacey, Inc., 45 West 18 Street, New York 11, New York

For more facts circle 869 on Reader Service card, p 227

The contributions C. H. Wheeler's Reverse Flow makes in solving CONDENSER MAINTENANCE PROBLEMS

An informative advertisement from one of the nation's most experienced condenser manufacturers

Since a major condenser maintenance problem is caused by foreign matter, algae and scale which clog tubes and sheets, there is a constant search for better ways to remove this contamination. One of the most successful methods is Reverse Flow (see diagram on right), a system of back-flushing tubes and sheets without shutting down the condenser.

This Reverse Flow design, patented by C. H. Wheeler Manufacturing Company, designer and builder of steam condensers since 1903, has proved itself in installations throughout the world. Here's how it works:

Normal operation is shown on the left. Water enters through inlet A with inside port open, flows through tube bank C to the rear of the condenser. It returns through tube bank D to the front of the condenser and discharges at E.

The right side of the diagram above shows Reverse Flow in operation in a C. H. Wheeler Dual Bank, Divided Water Box Condenser. Water enters through A with outside port open, flows up through channel B and through tube bank D to rear of condenser, returns through tube bank C to front of condenser and discharges at E. Reversing can be accomplished during full load operation and full flow of circulating water, without additional pressure loss. Sluice gates for each half of the condenser move on a common stem. Each half of the condenser can be back-flushed independently; or both halves can be back-flushed simultaneously with one or two circulating pumps operating.

Other Ways To Keep Tubes Clean

Special slugs are sometimes used to remove algae and foreign matter from the insides of condenser tubes. They're forced through the tubes by high-pressure water; thus scale and other contamination is flushed as it's dislodged. When the slugs are metal, care must be taken to prevent ruining them as they fly from the outlet side of the tubes.

Sometimes a 5% HCl solution is introduced into the tubes to dissolve the scale. While this method is effective, it is often necessary to leave the acid in the tubes for six hours or so—thus prolonging down time. Also, it's necessary to flush the tubes before the condenser can be put back in service.

In general, maintenance becomes more of a problem as water-source pollution increases; also as circulating water temperature rises, because the rate of scale formation increases at higher water temperatures.

Solving Deaeration Problems

Oxygen and other non-condensable vapors in the condensate result from leaks or are introduced through make-up water or heater returns. Most authorities believe that the greatest source of oxygen is make-up water.

Make-up water which is not properly heated in the condenser and agitated sufficiently to release entrained gases results in excessive oxygen and other non-condensables in the condensate. As a consequence, corrosive oxides may be deposited in the boiler, reducing its efficiency.

Proper distribution of normal make-up water is achieved in Wheeler condensers by spraying it over the top of the tube banks at both ends of the tubes, and out of the path of high-velocity steam from the turbine exhaust. Steel bars above tubes protect them from water impingement damage.

Heater returns are sprayed in the steam lanes to permit flashing and distribution of the returns and release of entrained gases.

All condensate draining off the tubes is cascaded over a series of horizontal deaerating bars (1, Fig. 3) in the presence of a moving blanket of steam to provide greater agitation and reheating before condensate is drained into the hotwell.

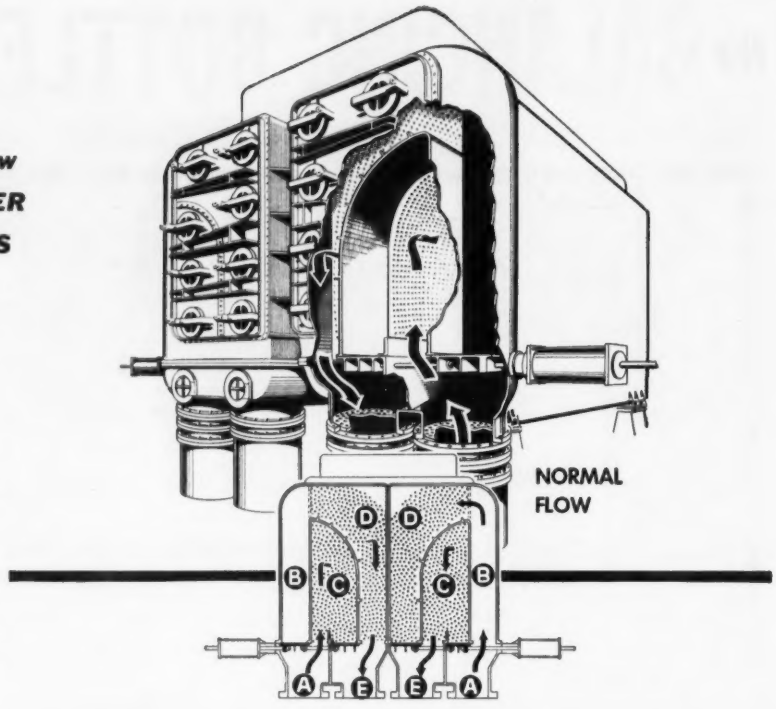


Fig. 1: Simplified diagram showing how Reverse Flow cleans tubes and sheets during full load operation.

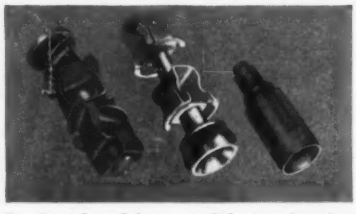


Fig. 2: A few of the types of slugs used to clean the inside of condenser tubes.

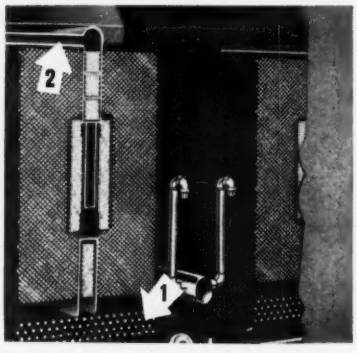


Fig. 3: Drawing of deaerating bars and air-vapor suction line. Tubejet® Air Ejector.

Notice too, location of the air-vapor suction line (2), through which the Tubejet® Ejector draws off non-condensable gases and discharges them to the atmosphere.

In C. H. Wheeler Dual Bank Divided Water Box Condensers the air cooler section is centrally located, so as to reduce depth of steam penetration and consequently resistance to steam passage, achieving a new low in pressure loss in the condenser.

If you have a maintenance problem that doesn't seem to improve no matter what you do, C. H. Wheeler may be able to help. Get in touch with a Wheeler representative or write direct. No obligation.

C. H. WHEELER MFG. CO.

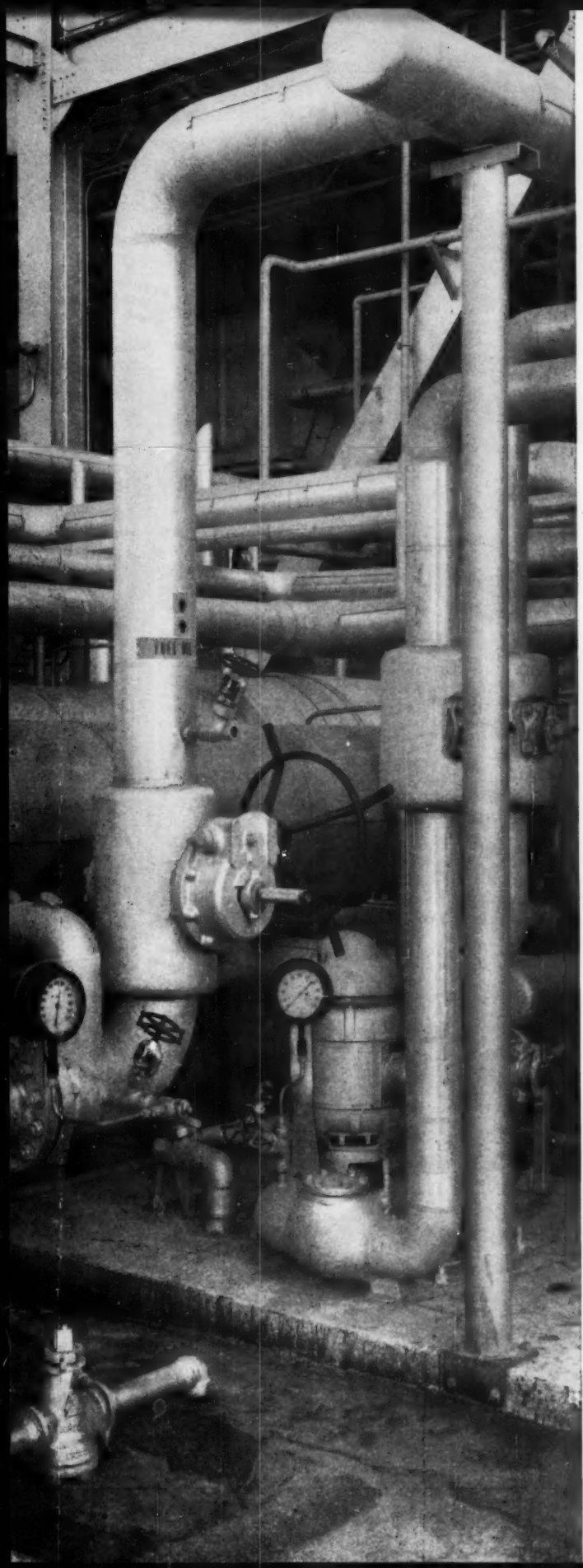
19th and Lehigh Avenue • Philadelphia 32, Pennsylvania

Whenever you see the name C.H. Wheeler on a product, you know it's a quality product.

Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Components

For more facts circle 870 on Reader Service card, p 227

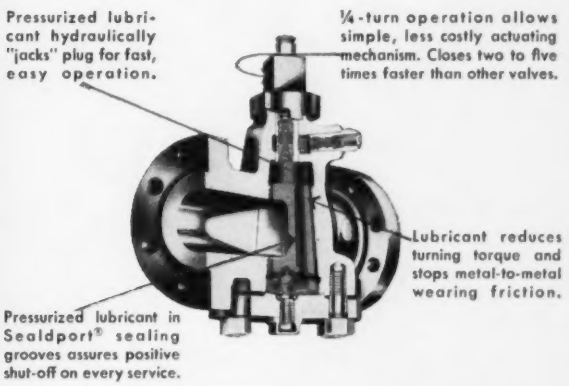
circle 871 on Reader Service card, p 227 ➤



CAN FUEL OIL LINES BE SHUT-OFF FAST AND TIGHT?

It only takes one fuel oil line emergency to dramatically show that most valves close too slowly or fail to shut-off tightly. To *insure* fast, tight shut-off, many power engineers are specifying Rockwell-Nordstrom valves. For some of the logic behind their choice, look at the drawing of the cut-away valve below. Notice that the plug fully opens or closes the valve with just a quarter-turn . . . as opposed to dozens of turns needed to close other valves. And see how the plug is positively sealed by pressurized lubricant (heavy red lines) . . . there are no exposed metal-to-metal seats to wear out, corrode or chatter.

The drawing also shows just a few of many other performance advantages of Rockwell-Nordstrom valves for handling fuel oils . . . or any gas or liquid. The smoothly contoured body has no gaping cavity to collect sediment and perhaps jam the seats. And the heavy red section at the top of the plug illustrates the pressurized lubricant that hydraulically cushions the plug for instant operation whether the valve is opened once an hour or once a year. Lubrication saves money too. It prevents the metal-to-metal wearing friction that can quickly ruin "dry" valves.


Pressurized lubricant hydraulically "jacks" plug for fast, easy operation.
¼-turn operation allows simple, less costly actuating mechanism. Closes two to five times faster than other valves.
Lubricant reduces turning torque and stops metal-to-metal wearing friction.
Pressurized lubricant in Sealdport® sealing grooves assures positive shut-off on every service.

Rockwell-Nordstrom valves, the world's most complete line of lubricated plug valves, cost no more to buy—often less—than ordinary valves. You can get complete details, or have a Rockwell Field Engineer visit you by writing to Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

ROCKWELL-Nordstrom VALVES

another fine product by

ROCKWELL

Rockwell-Nordstrom Hypreseal valves, (bottom center uninsulated, center insulated, worm gear operated) on high pressure hot oil lines at large western power station.

COMMONWEALTH EDISON COMPANY
Chicago, Illinois
COLUMBUS & SOUTHERN OHIO ELECTRIC COMPANY
Columbus, Ohio
CENTRAL POWER & LIGHT COMPANY
Corpus Christi, Texas
CENTRAL ILLINOIS PUBLIC SERVICE COMPANY
Springfield, Illinois
DALLAS POWER & LIGHT COMPANY
Dallas, Texas
CONNECTICUT LIGHT & POWER COMPANY
Berlin, Connecticut
DELAWARE POWER & LIGHT COMPANY
Delaware City, Delaware
CONSUMERS POWER COMPANY
Jackson, Michigan
CINCINNATI GAS & ELECTRIC COMPANY
Cincinnati, Ohio
EL PASO ELECTRIC COMPANY
El Paso, Texas
FLORIDA POWER CORPORATION
St. Petersburg, Florida
LONG ISLAND LIGHTING COMPANY
Long Island, New York
HOUSTON LIGHTING & POWER COMPANY
Houston, Texas
KANSAS GAS & ELECTRIC COMPANY
Wichita, Kansas
MISSISSIPPI POWER COMPANY
Gulfport, Mississippi
OHIO EDISON COMPANY
Akron, Ohio
OKLAHOMA GAS & ELECTRIC COMPANY
Oklahoma City, Oklahoma
NIAGARA MOHAWK POWER CORPORATION
Syracuse, New York
PUBLIC SERVICE COMPANY OF NEW MEXICO
Albuquerque, New Mexico
ROCKLAND LIGHT & POWER COMPANY
Nyack, New York
PENNSYLVANIA ELECTRIC COMPANY
Johnstown, Pennsylvania
PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
Manchester, New Hampshire
SAN DIEGO GAS & ELECTRIC COMPANY
San Diego, California
TEXAS ELECTRIC SERVICE COMPANY
Ft. Worth, Texas
PUBLIC SERVICE COMPANY OF OKLAHOMA
Tulsa, Oklahoma
SOUTHERN CALIFORNIA EDISON COMPANY
Los Angeles, California
SOUTHERN ELECTRIC GENERATING COMPANY
Birmingham, Alabama
SOUTHWESTERN GAS & ELECTRIC COMPANY
Shreveport, Louisiana
TEXAS POWER & LIGHT COMPANY
Dallas, Texas

CAROLINA POWER & LIGHT COMPANY
Raleigh, North Carolina

CALIFORNIA ELECTRIC POWER COMPANY
Riverside, California

ARKANSAS POWER & LIGHT COMPANY
Little Rock, Arkansas

ALABAMA POWER COMPANY
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CENTRAL ILLINOIS ELECTRIC & GAS COMPANY
Rockford, Illinois

ATLANTIC CITY ELECTRIC COMPANY
Atlantic City, New Jersey

ARIZONA PUBLIC SERVICE COMPANY
Phoenix, Arizona

IN ORBIT with PACIFIC...

This galaxy of steam power generating plants produces a substantial portion of America's electrical output on an uninterrupted round-the-clock basis year after year. Pacific Boiler Feed Pumps are also delivering uninterrupted service within the stations of this impressive constellation of electrical power generating companies.

Send for your copy of the Pacific Type BFI Centrifugal Boiler Feed Pump Bulletin 122A.

PACIFIC PUMPS
Inc... A Division of Dresser Industries, Inc.
HUNTINGTON PARK, CALIFORNIA

UTAH POWER & LIGHT COMPANY
Salt Lake City, Utah

MEMPHIS LIGHT, GAS & WATER DIVISION
Memphis, Tenn.

UNITED ILLUMINATING COMPANY
New Haven, Connecticut

...AND MANY OTHERS

TUCSON GAS, ELECTRIC LIGHT & POWER COMPANY
Tucson, Arizona

ONE OF THE DRESSER INDUSTRIES

PACIFIC®

For more data circle 172 on Reader Service card, p 210

Only Grinnell has a complete line of pipe

With 8 . . . 9 . . . even 10 inches of thermal movement not a bit unusual in today's high temperature piping systems, complete support for piping in all positions of travel is vital.

SAFETY OF ENTIRE SYSTEM AT STAKE

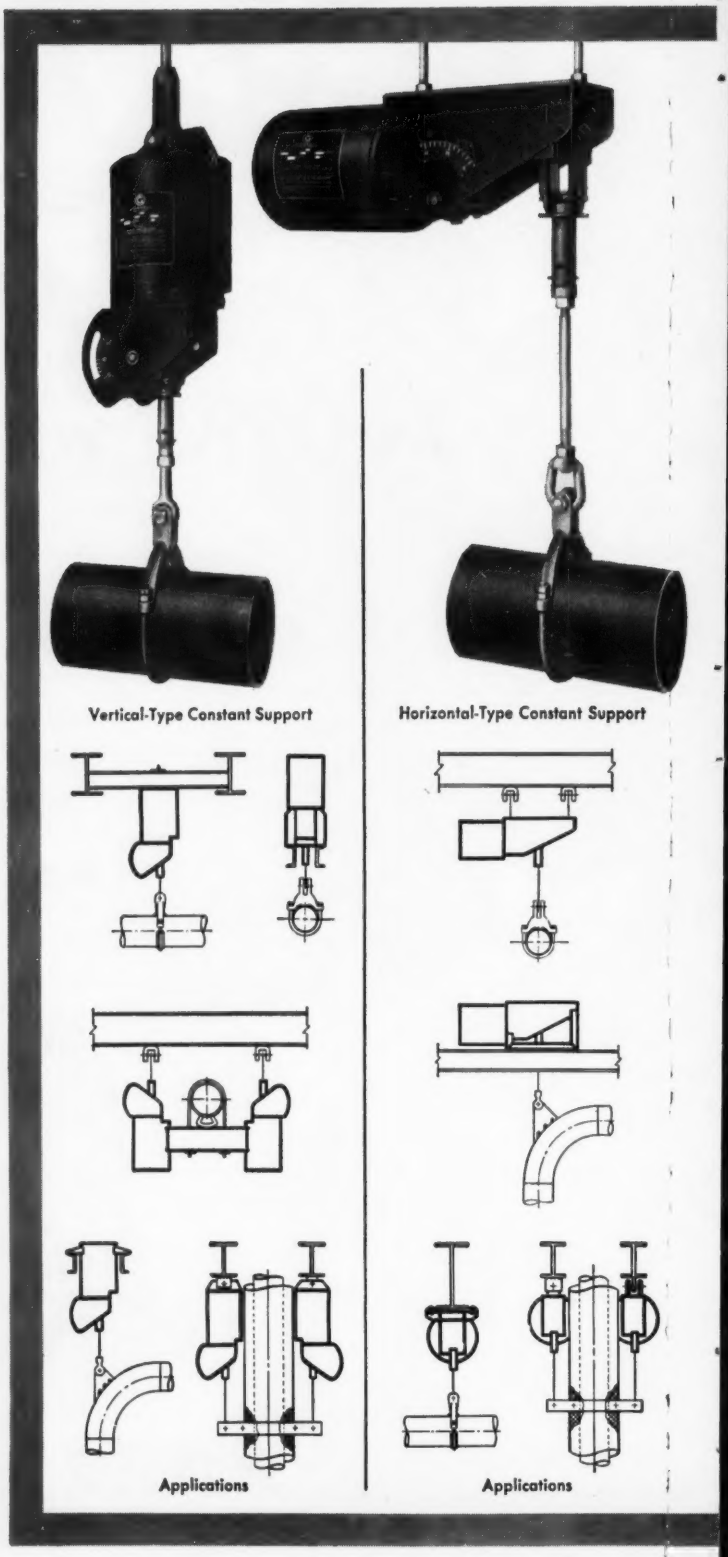
Helical coil springs are widely used to provide for thermal expansion. But the design or selection of flexible supports often is haphazard. Unless careful study is given to the design and choice of spring supports, the transfer of weight from one hanger to another, or from hanger to terminal points, can endanger the safety factor of the entire system.

MATHEMATICALLY PERFECT GRINNELL CONSTANT SUPPORTS

Grinnell Constant Supports are the result of a century of experience in the industrial piping field. A patented geometric design, exclusive with Grinnell Constant Supports, assures mathematically perfect load support throughout all positions of travel. There is also a full 70 percentage points of adjustability built into them. No less than 10 percent of this adjustability is allowed either side of calibration for plus or minus change in load. Field readjustments are easily made by turning a single load adjustment bolt. These hangers are designed to provide uniform supporting force equal to the pipe load throughout the travel range — and should be used at selected points on critical lines, as for example at turbine connections.

Available in 11 Different Types

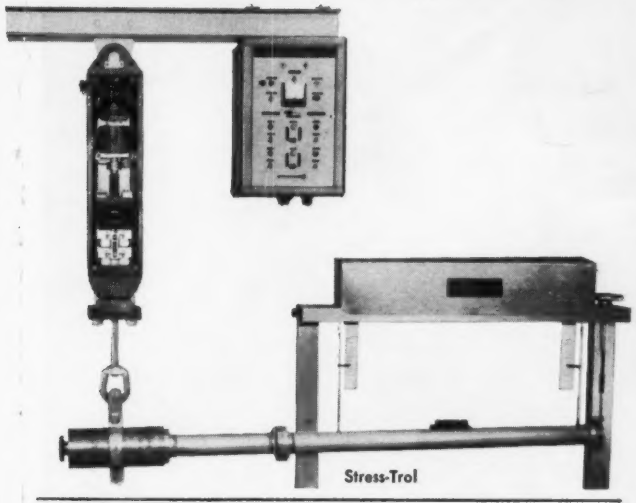
Grinnell Constant Supports are available in eleven types for a complete choice of mounting positions; above, between, or below structural steel. This choice includes both vertical and horizontal design to fit compactly into available headroom space. Even with this wide choice, Grinnell Constant Support Hangers provide mathematically perfect support through *all* ranges of travel, regardless of field adjustments.



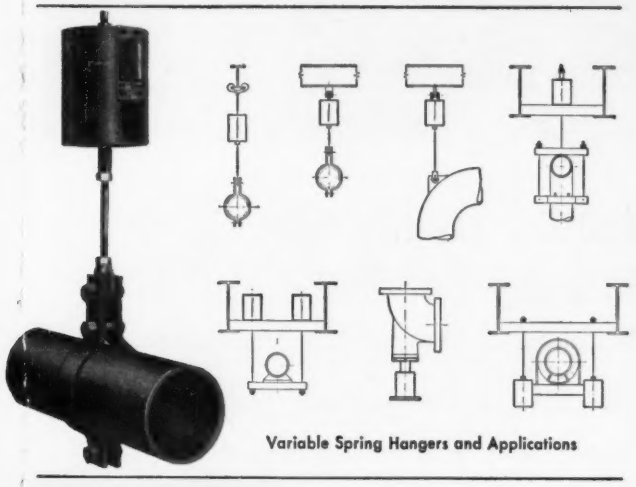
GRINNELL

AMERICA'S No. 1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

hangers to provide for thermal expansion



Stress-Trol



Variable Spring Hangers and Applications

Vibration Control and Sway Brace

Light-Duty Hangers

GRINNELL STRESS-TROL* FOR POSITION AND/OR LOAD CONTROL

Keeping the footage of high pressure-high temperature fabricated piping to a minimum has become important because of high piping costs. This can be accomplished by reducing the length of long expansion bends, but providing support for shorter, less flexible lengths of piping presents a new problem. Grinnell Stress-Trol, a motor operated device, solves this problem. It provides:

Position Control — that minimizes stresses in piping and reactions on connected equipment.

Load Control — that is constant support with unlimited load and travel capacities.

GRINNELL VARIABLE SPRING HANGERS

When pipe lines are subject to relatively small vertical movement, and do not require a constant support type hanger, Grinnell Variable Spring Hangers are available. The maximum variation in supporting force for standard spring models per ½ inch deflection is 10% of rated capacity. Grinnell offers these hangers in 21 sizes — in short, standard and double spring models, plus a special corrosion-resistant model. There are 7 different methods of attachment.

GRINNELL VIBRATION CONTROL AND SWAY BRACE

When necessary to prevent undesirable movement in lines, Grinnell Vibration Controls and Sway Braces of the energy storing and instant-acting counter force type are recommended. They dampen vibration, oppose pipe sway and absorb shock.

GRINNELL LIGHT-DUTY SPRING HANGERS

Finally, simple and inexpensive adjustable light-duty spring hangers often are all that's required to support piping safely. Grinnell has a complete line of light-duty hangers. They are designed for easy installation and quick, accurate alignment of piping.

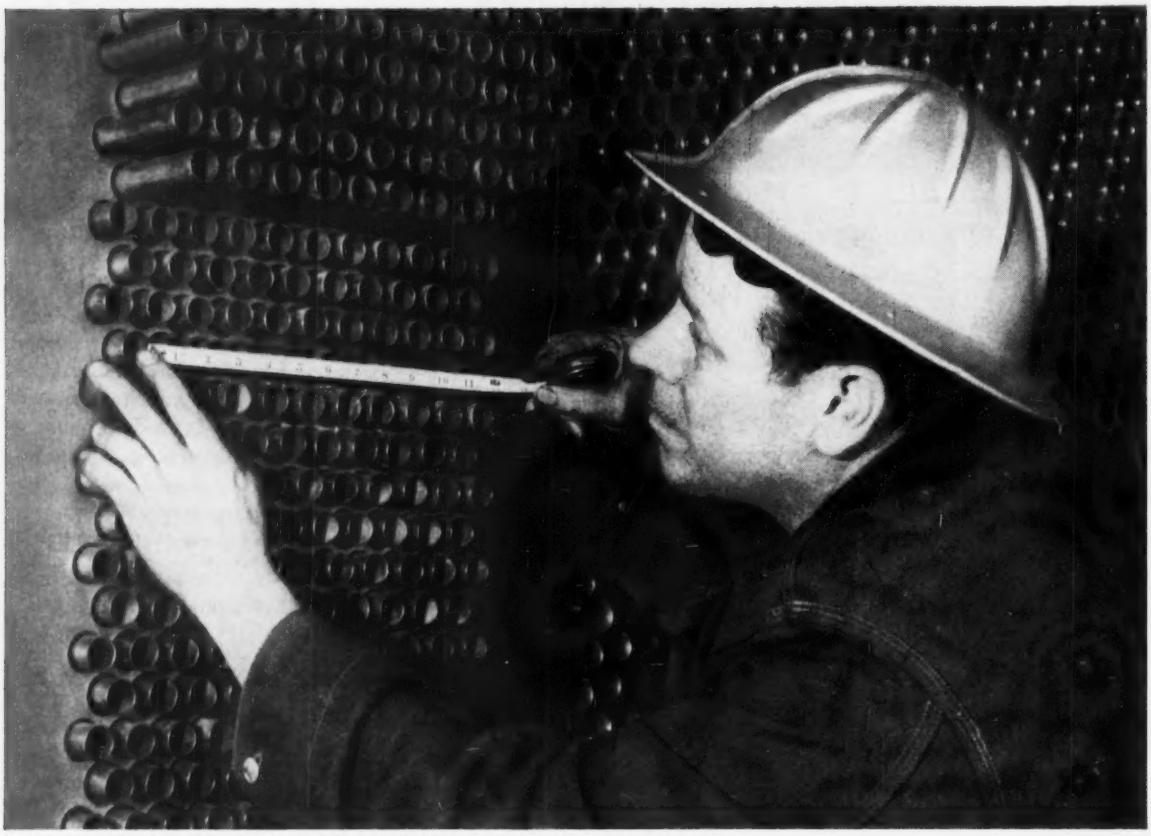
Whatever your pipe suspension needs, Grinnell can supply them. Grinnell Company, 260 West Exchange Street, Providence 1, Rhode Island.

Patents Applied For

GRINNELL

BRANCH WAREHOUSES AND DISTRIBUTORS IN PRINCIPAL CITIES

For more facts circle 874 on Reader Service card, p 227



Worker inspecting and measuring some of the installed tubes after insertion in the condenser.

Cooling Atomic-Heated Steam with Chase® Phosphorized Admiralty Condenser Tubes

Dresden Nuclear Power Station to Add 180,000 KW to Commonwealth Edison Output

Part of the 16,700 condenser tubes now being installed at Dresden Nuclear Power Station, located near Morris, Illinois.

The new Dresden Nuclear Power Station of Commonwealth Edison will generate an additional 180,000 KW of electrical power for northern Illinois. The fission of uranium provides heat, boiling water up to 1,000 psi and 545°F. Steam reaching the condenser carries 1010 BTU/Lb and passes over the condenser tubes at a rate of about 25,500 Lbs/Min.

More than 70 tons of Chase phosphorized admiralty condenser tubes are used in the condenser whose job is to condense the steam in order that it can be recirculated in the system on a continuing cycle.

Whenever steam is condensed back to water you'll find a Chase® condenser tube that's ideal for the job. Your nearest Chase Office can give you specific help in selecting the alloy for best results... for either new or re-tubing jobs. Or write to Chase at Waterbury 20, Connecticut.

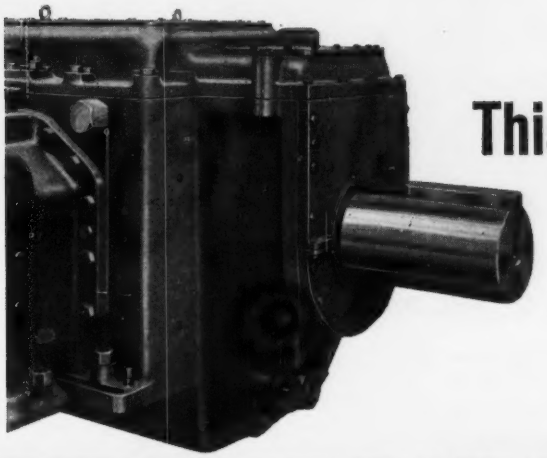
Chase **BRASS & COPPER CO.** WATERBURY 20, CONN.
Subsidiary of ***Kennecott Copper Corporation***

MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY BRASS & COPPER

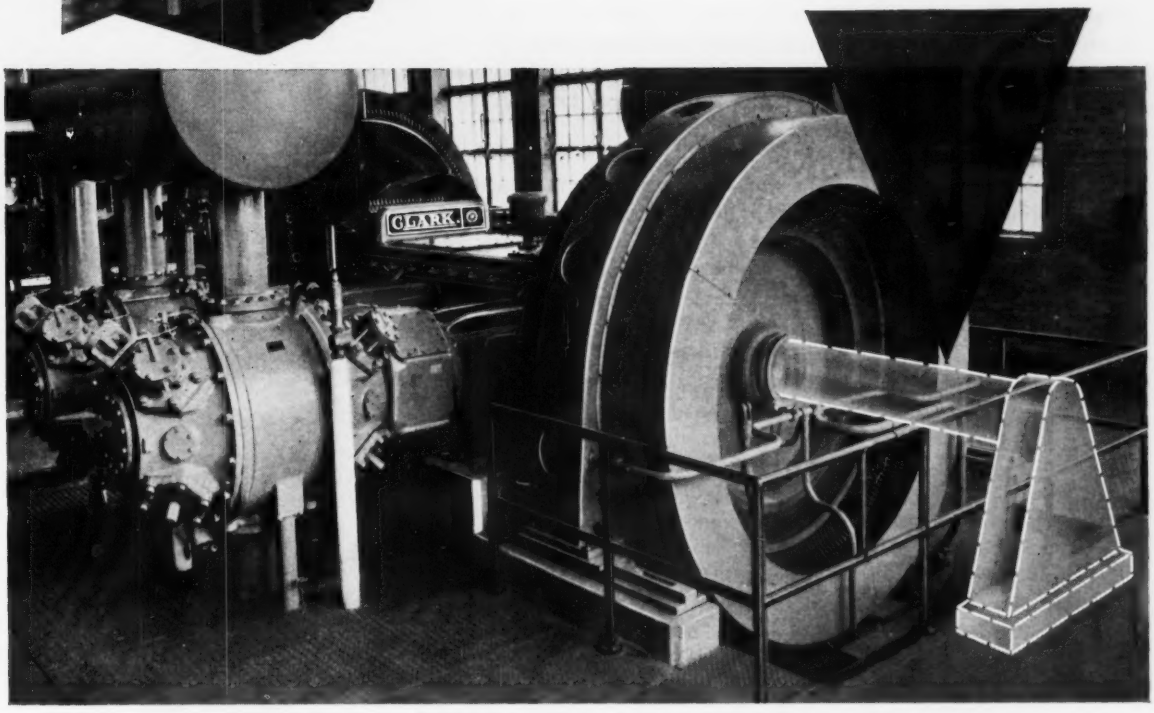
THE NATION'S HEADQUARTERS FOR **ALUMINUM • BRASS • BRONZE • COPPER • STAINLESS STEEL AND FORGINGS**

Atlanta Baltimore Boston Charlotte Chicago Cincinnati Cleveland Dallas Denver Detroit Grand Rapids Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York (Maspeth, L. I.) Philadelphia Pittsburgh Providence Rochester St. Louis San Francisco Seattle Waterbury

For more facts circle 875 on Reader Service card, p 227



This Clark development eliminates outboard bearings



In 10 years, in hundreds of installations, NEVER a motor end-bearing failure!

Since Clark introduced *overhung rotor construction* in its Balanced/Opposed compressors a decade ago, hundreds of these air compressors have been built. Proof of the dependability of this design feature is the fact that not one motor end-bearing failure has occurred in over ten years.

Heavy duty crankcases and generously proportioned crankshafts and main bearings are the main reasons for this proved dependability. Here are additional advantages of Clark overhung rotor design:

EASIER INSTALLATION – Mounting the rotor directly on the crankshaft simplifies installation. Just align the stator to the rotor – that's all.

LESS MAINTENANCE – There is no outboard bearing to be knocked out of alignment. Motor bearing is integral with crankcase, lubrication is automatic. Self-centering of the rotor within the stator removes rotor weight from the bearing during operation.

SIMPLER DESIGN – One piece collector rings. Flywheel effect in most instances is completely built into the rotor thereby eliminating the flywheel.

LESS FLOOR SPACE – Close coupling reduces foundation requirements.

Overhung rotor construction is only one of many features found in Clark Balanced/Opposed Compressors. Review your requirements with your Clark representative for all the facts.

CLARK BROS. CO. OLEAN, NEW YORK
One of the Dresser Industries
ENGINES • COMPRESSORS • GAS TURBINES

CLARK

For more facts circle 876 on Reader Service card, p 227

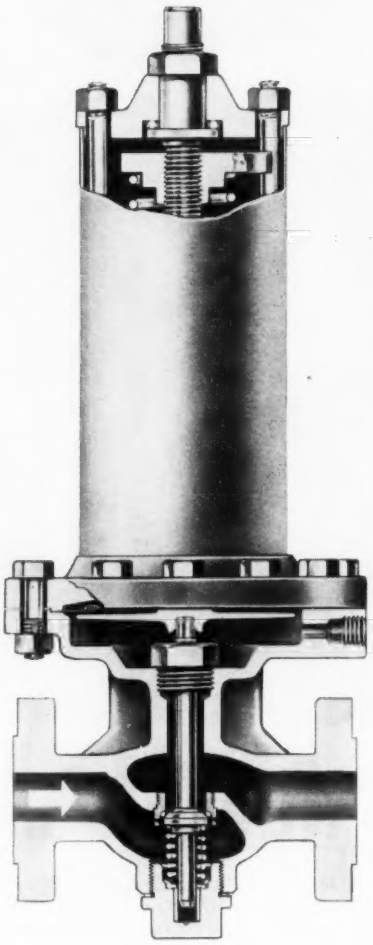
NOW ADDED TO LESLIE's COMPLETE LINE...

TWO NEW CONCEPTS IN

NEW LESLIE-TOPPER® VALVE DESIGNED WITH PILOTING DEVICE ENTIRELY *OUT OF THE PATH OF STEAM*

The new Leslie Topper self-contained pressure reducing valve offers a new level of accuracy, simplicity and low-maintenance service (see chart below). Key to this revolutionary valve is a piloting device which is entirely out of the path of steam. Because this mechanical pilot is sealed-off from the steam and all valve parts are designed without dirt-catching passages, the new Topper valve is ideal for both poor steam conditions and intermittent duty.

It can handle low-reduced pressures and is used in process lines, steam heat reducing stations and for make-up steam supply to heaters, gland sealing system and process equipment. You benefit from added reliability, plus the accuracy of a pilot operated valve and the rugged simplicity of direct operation. It means less shut-down time for maintenance, surer pressure control and increased plant efficiency.



SPECIFICATIONS

Sizes, Body Materials and End Connection:
½—2", cast iron, and bronze, screwed, 150 and 300 lb. bronze, flanged.
1—2" 125 and 250 lb. cast iron, flanged bodies.

Three Spring Ranges: *2-10 psi; 5-20 psi; 15-35 psi.*

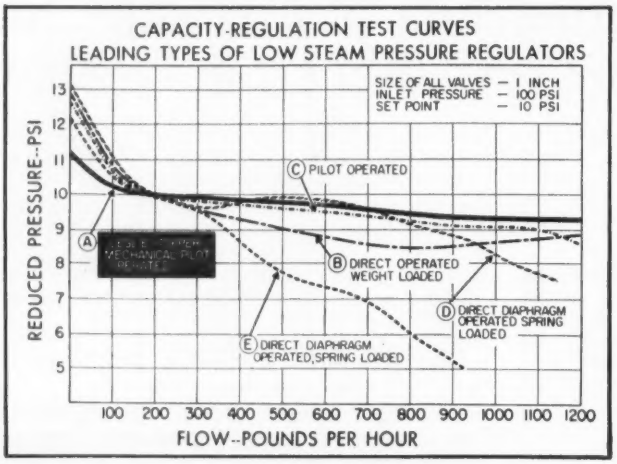
Long-travel metal diaphragm: *2 ply, phosphor bronze, Spiro-flex.®*

Main Valve: *Hardened 440C stainless steel.*

Seat Ring: *Stellited stainless steel.*

Stem Guides: *Gun metal bronze (top and bottom guided).*

Main Valve Spring: *Inconel.*



For sizing and capacity data, contact your Leslie Engineer or write for Bulletin 582.

LC-8

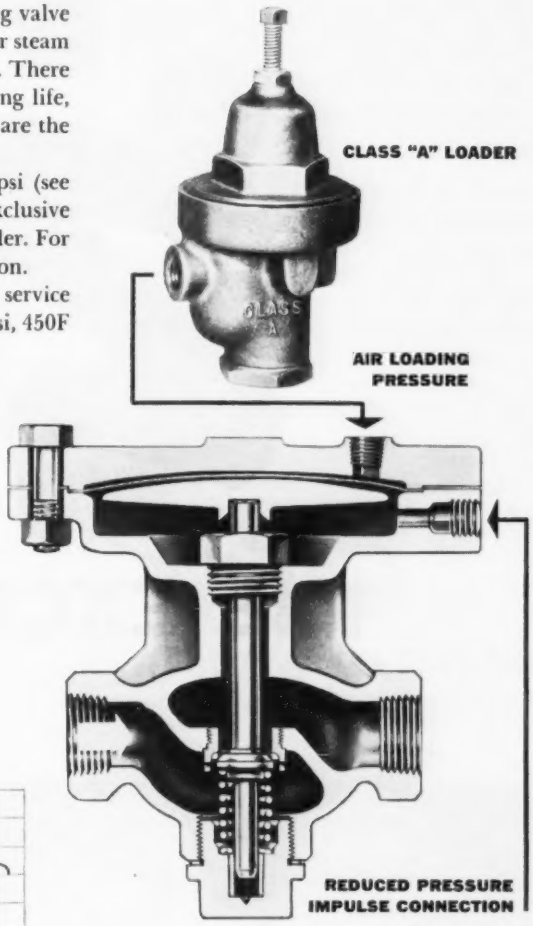
PRESSURE REDUCING VALVES

LESLIE AIR-LOADED REDUCING VALVE GUARANTEED MAINTENANCE-FREE FOR THREE FULL YEARS

New Leslie air-top GPK diaphragm operated, pressure reducing valve is guaranteed maintenance-free for three full years. Designed for steam heat or process steam application, it has only two moving parts. There are no seals, no stuffing boxes, no small dirt catching parts. Long life, long-travel diaphragm and hardened stainless steel main valve are the only parts that move.

You get accurate response even to flow changes as small as 0.1 psi (see chart below). This exceptional responsiveness results from exclusive diaphragm design and the accuracy of the simple Leslie air loader. For added flexibility, pressure can be adjusted from remote location.

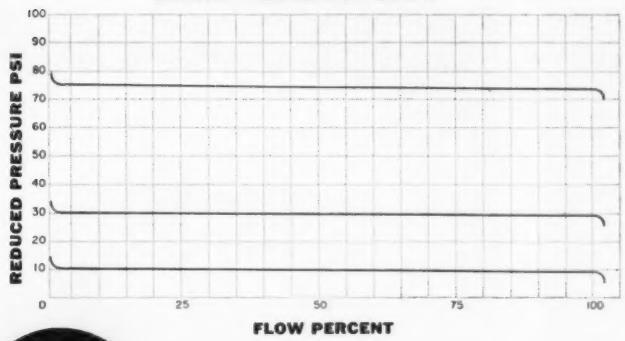
Especially desirable for poor steam conditions and standby service requirements, the GPK is suitable for steam service up to 250 psi, 450F and is available in ½" to 4" sizes.



SPECIFICATIONS

Sizes: *½ to 2", cast iron or bronze, screwed ends. 2½, 3 and 4", cast iron, 125 or 250 lb. flanged.*
Main Valve: *Hardened 440C Stainless Steel.*
Seat Ring: *Stellited Stainless Steel.*
Stem Guides: *Gun Metal Bronze (top and bottom guided).*
Main Valve Spring: *Inconel.*
Inlet Pressure Range: *0-250 psi, 450°F.*
Reduced Pressure Range: *0-85 psi with Class A loader, up to 249 ½ psi with any suitable high pressure loader.*
Minimum Pressure Drop across Valve: *½ psi.*
Available with manual opening device in sizes ½—1¼".

CAPACITY-REGULATION GRAPH



For sizing and capacity data, contact your Leslie Engineer or write for Bulletin 561-B.

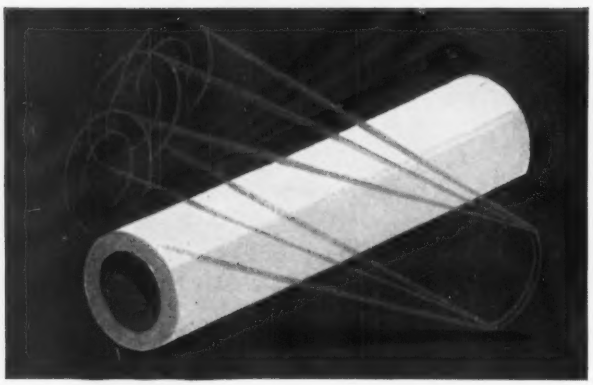
TRADE LESLIE MARK

REGULATORS and CONTROLLERS
Leslie Co., 435-D Grant Avenue, Lyndhurst, New Jersey
Over 275 Factory-Trained Engineers At Your Service—Nationwide!

For more facts circle 877 on Reader Service card, p 227

K&M ZEBRA

THE EXCITING NEW PIPE



ZEBRA drops without cracking! This remarkable new insulating material withstands repeated drops up to 17 inches without cracking . . . in increments of 1 inch.

ZEBRA bends without cracking! "K&M" ZEBRA takes a high degree of bending because its deflection at breaking load is four to ten times that of ordinary insulations.

for temperatures of 200°F to 1200°F

Remarkable new "K&M" ZEBRA is a high, medium, and low temperature pipe insulation, available sectionally in a wide variety of pipe sizes and thicknesses.

It has come through with flying colors in tests conducted by both "K&M" engineers and the U.S. Testing Corporation.

These tests prove that "K&M" ZEBRA withstands shock and heat without warping or cracking. It's quick and easy to handle and install . . . with minimum loss due to breakage. In addition, "K&M" ZEBRA meets your requirements for density, conductivity, modulus of rupture, and the ability to withstand soaking heat.

"K&M" ZEBRA is a multi-layer sectional-type thermal insulation primarily composed of calcium silicate-asbestos fiber bonded felts. It's the result of long "K&M" experience in the manufacture of high- and low-pressure insulations, pipe and block insulations, cements, and textiles.

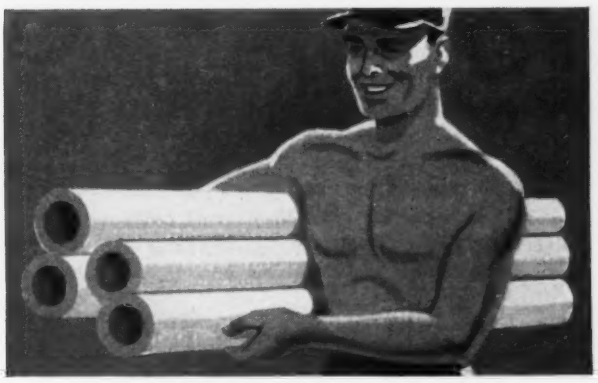
More information on this years-ahead insulating material is now available. Write to us today.

RA INSULATION

K·M BEST IN ASBESTOS

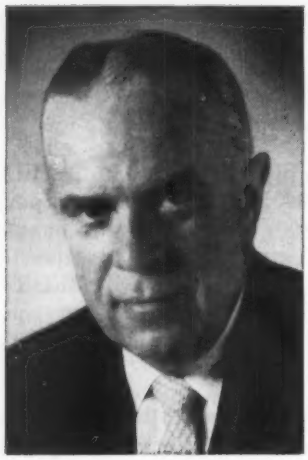
KEASBEY & MATTISON
Company • Ambler • Pennsylvania

ZEBRA Installs in ⅓ the time! Tests prove you can install 2 sections of 3" x 3" "K&M" ZEBRA in only 5.52 minutes as compared to 16.25 minutes for a two-layer segmental construction.



ZEBRA won't cause skin irritation! The smooth surface of "K&M" ZEBRA prevents both the irritation of the skin and its penetration by ragged projections.

How McGraw-Hill Circulation



Advertisers today are asking for more and more evidence on which to base their media decisions. This is a healthy attitude that we heartily encourage.

One subject on which we are often queried is circulation. From time to time, therefore, I believe it is helpful for us to restate and re-emphasize McGraw-Hill's basic circulation philosophy.

I am consequently using this method of frankly answering some questions that have been asked by agencies and advertisers.

Nelson L. Bond

PRESIDENT, PUBLICATIONS DIVISION

1.

Why does McGraw-Hill believe so strongly in paid circulation?

Fundamentally, because payment for a product represents the normal and natural way of doing business. Agencies sell their services, advertisers sell their products. The general magazines and newspapers of this country are sold, to subscribers or on newsstands. We're no different from these agencies, advertisers and other media. We simply share their belief in the cardinal rule, "If something has value it can be sold."

2.

Does paid circulation guarantee readership?

No. Payment for a subscription, however, certainly indicates an intent to read. The subscriber expresses this intent in the simplest and most universally recognized form—money. Having expressed it, he retains full freedom of choice. If he doesn't read the publication, he won't continue to pay for it.

Further evidence of readership of a publication by its paid subscribers is contained in a recent Laboratory of Advertising Performance study. (Laboratory of Advertising Performance Sheet 1195 will be sent on request.)

3.

Can paid circulation really provide "100% market coverage"?

No, especially if you interpret coverage as readership, not just receivership. We recognize that there are in every market a certain number of people who do not and will not read any publication; you can lead them to water but you can't make them drink. Nobody is going to get their attention as readers.

There is another group of people who can be reached only by McGraw-Hill's type of vigorous, persistent circulation selling activity. By direct mail, our own field salesmen, and by issue cards, we uncover many of the "hidden buying influences" who are important to market coverage, but who are not listed in directories or registration rosters.

McGraw-Hill publications provide representative, selective circulation in the markets they serve. Both the quantity and the quality of the subscribers are identified by actual audit of paid transactions. This provides the advertiser with documented answers to two basic questions about the audience he is buying: "Who are these people?" "How many of them?"

4.

Does paid circulation guarantee "editorial quality"?

In our view, "editorial quality" is measured directly by the publication's usefulness to the reader. If the editorial content does not match his job interests, serve his needs, help solve his problems and compel his continuing attention, it is not of real use.

If it isn't useful, he will neither buy the publication nor read it.

Paid circulation means that we have accepted the challenge of placing our editorial services on the block. We have given every reader the option of deciding on the value of this editorial service to *him*. He casts his ballot, for or against, when he first subscribes and every time he comes up for renewal.

Editorial quality, or usefulness to the reader, thus is judged, not on a theoretical basis, but on the hard fact of a "sale" or "no-sale" decision by the publication's audience.

Policies Benefit Advertisers

5.

Doesn't it cost more to sell subscriptions than to give them away?

It is possible that, on some publications, selling costs may temporarily exceed subscription income. Usually this is because of circulation growth factors involved in the sale of new subscriptions. However, the economics of paid circulation are not based on selling new subscriptions only, but on the lower cost of renewals as well.

For example, over the last ten years, McGraw-Hill publications have collected more than $42,700,000 in subscription fees. The total of all expenses involved in the procurement (sales and collection) of these subscriptions amounted to just over $34,700,000. This gave us a subscription sales margin of about $8,000,000, plus the valuable privilege of mailing under second class postage rates. The subscriber, therefore, has shared in the costs of our publishing operation.

6.

Doesn't paid circulation mean that you have to accept all subscriptions, regardless of quality?

Not at all. Subscriptions are solicited and accepted only from people who meet the circulation *specifications* set by each publication. These standards are clearly defined, and can be examined by any interested advertiser or agency. These standards result in audiences of men who benefit from the publication's editorial contents and whose buying power benefits the advertiser.

We make clear in the masthead of each publication that we do not offer the publications to everyone who wants to subscribe. On the average, we decline about 20,000 subscriptions a year from people who, based on our specifications, would not benefit from receiving the publications. (Current listings of subscriptions recently declined are available on request.)

In addition, the nature of our publications' editorial contents, and the subscription payments screen out people who do not meet circulation specifications.

7.

Is it true that some people don't pay for their own subscriptions?

In some cases, yes. A study of our subscribers shows that 17.3% of subscriptions are ordered and paid for by the company. Another 32.7% are paid for by the company, but requested by the individual. The remaining 50.0% are paid for by the individual subscriber himself. So, 82.7%* of the subscriptions are delivered on the request and initiative of the individual. As to the remaining 17.3%, the company that buys for its key employes undoubtedly makes sure of the usefulness of the publication —particularly since it has to be renewed periodically by the payment of company funds.

8.

What does paid circulation mean to the advertiser?

Many things. But most directly and most importantly it means more evidence, and better evidence, as to publication values. Namely:

- Evidence of active interest in the publication, as represented by payment for a subscription.
- Evidence, in the same tangible form, of an *intent* to read the publication.
- Evidence of editorial quality, as represented by the interest and intent referred to above.
- Evidence of the reader's true evaluation of the usefulness of the publication, as represented by payment for renewal subscriptions.
- Evidence of active circulation, as represented by subscriber action in correcting and keeping up-to-date circulation lists.

**Figures from Laboratory of Advertising Performance, Sheet 1114, will be sent on request.*

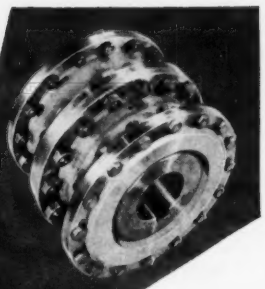
This, of course, is not the complete story. Intangible benefits accrue from circulation policies based on the sound initial premise that the subscriber must be served first. Paid circulation, although an integral part, is certainly not the only ingredient of our publishing philosophy. We hope, however, that the foregoing answers have been of value in clarifying our position on this vital part. If you have further questions, won't you please contact your local McGraw-Hill representative? Or write directly to us.

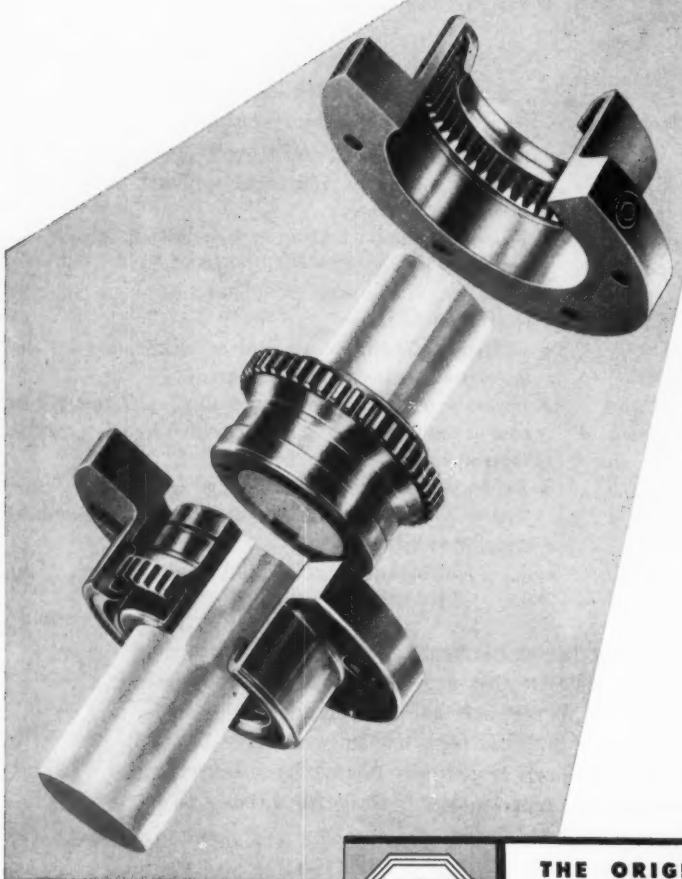
McGraw-Hill

PUBLICATIONS

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42nd ST., NEW YORK 36, N. Y.

the basic coupling principle that couldn't be improved . . .





This principle makes every Fast's coupling . . . large or small . . . out-perform all others

The principle embodied in Koppers gear-type, self-aligning Fast's couplings couldn't be improved by anyone. Throughout industry, Fast's couplings are accepted as the most dependable couplings on the market. Experience has proved that they frequently *outlast the equipment* they connect.

Fast's couplings are sufficiently comprehensive in types, sizes and versatility to meet almost every known need for couplings. Available in forged steel for shaft sizes from ¾″ to 6⅜″ and in cast steel for shaft sizes from 5½″ to 32″.

Nearly 40 years of coupling experience guarantees that Koppers can supply the right coupling engineered for a given application. For the booklet describing Fast's couplings applicable to your equipment, write today to: KOPPERS COMPANY, INC., Fast's Coupling Department, 5310 Scott Street, Baltimore 3, Maryland.

KOPPERS

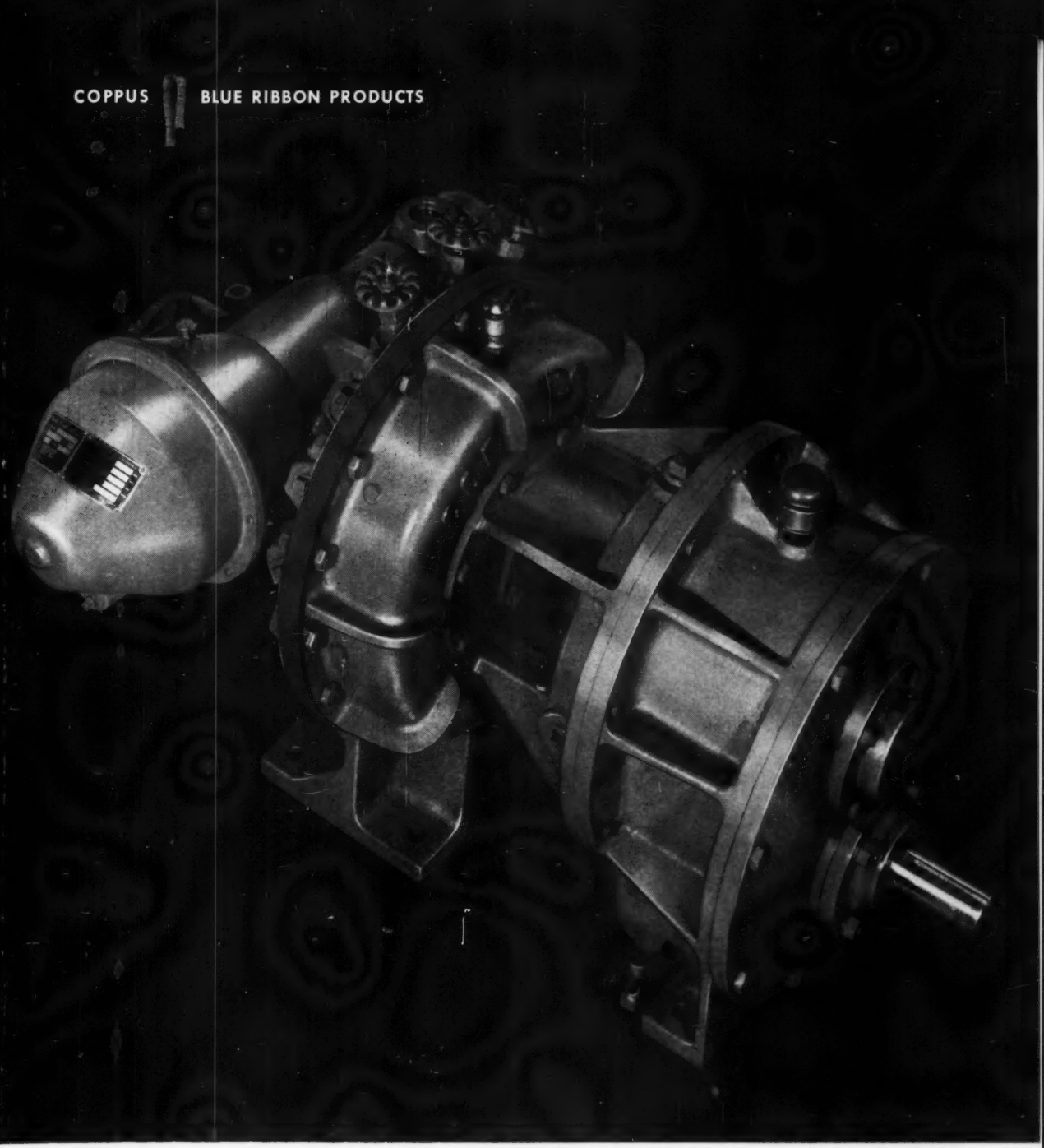
THE ORIGINAL

FAST'S Couplings

Engineered Products Sold with *Service*

For more facts circle 881 on Reader Service card, p 227

COPPUS BLUE RIBBON PRODUCTS



Coppus Steam Turbine with Built-In Speed Reducer

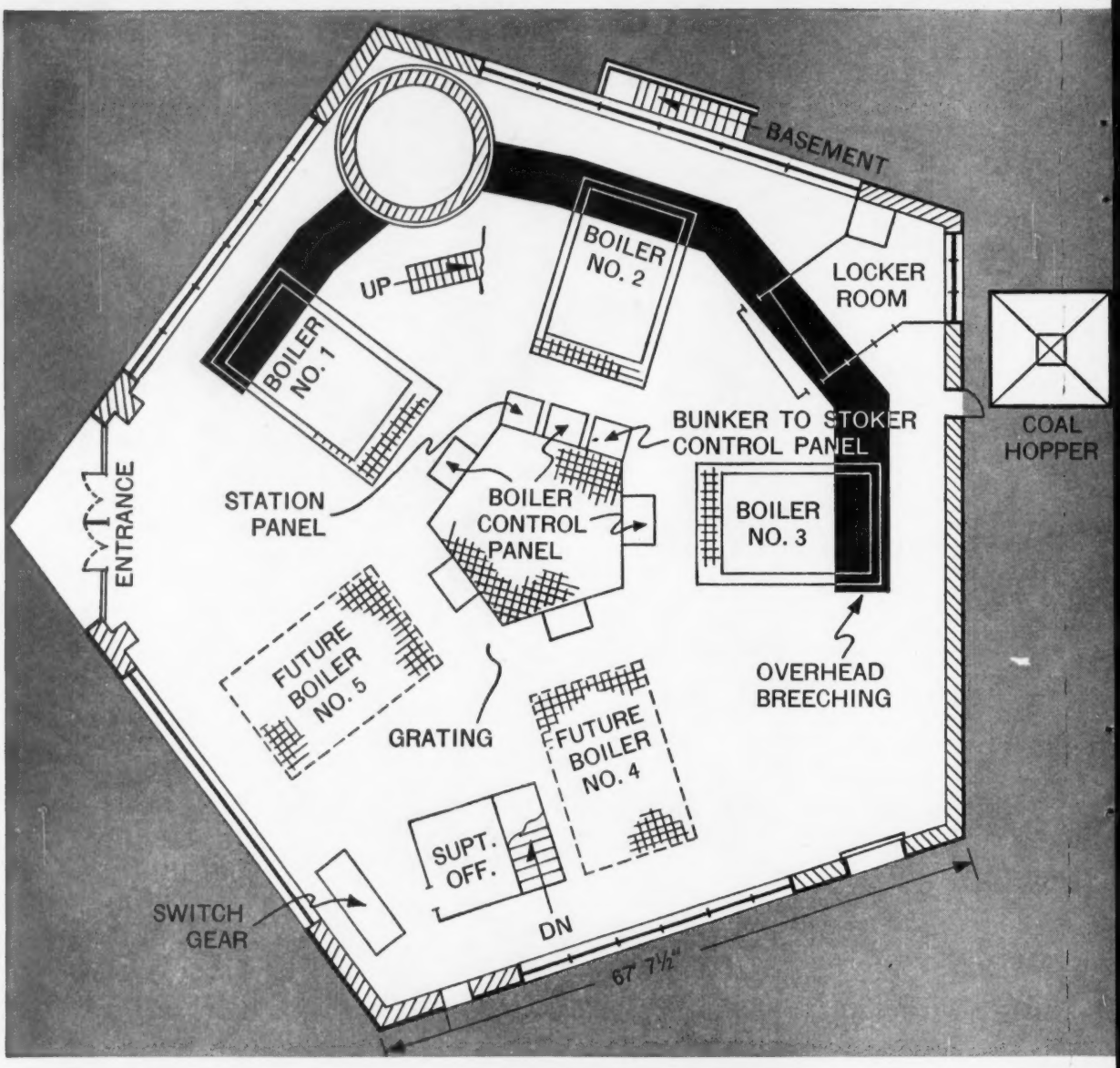
STAMINA — You can literally *see* stamina in every dimension of a Coppus Turbine . . . rugged reliability that assures you stable, positive performance. It truly "wins" the Blue Ribbon with which it is marked . . . through advanced design, top quality materials, and thorough testing. With Coppus you're always certain of Blue Ribbon features such as these —

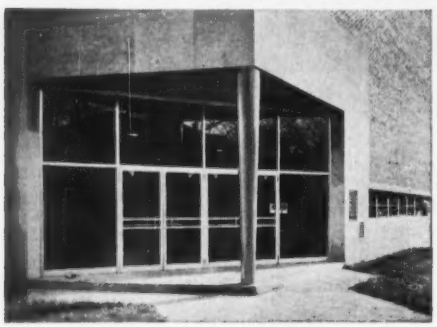
A totally enclosed governor . . . totally enclosed, independently operated safety trip . . . easily replaceable packing and bearings . . . multiple steam nozzle control . . . brake rim for added safety . . . wide bucket "L" type wheel (optional) for minimum water rate.

Coppus Turbines are built to customers' specifications, including API and NEMA standards. Sizes from 1 HP to 250 HP. All Coppus Products carry the same Blue Ribbon assurance of reliable performance. For further facts on turbines, send for new Catalog 200. COPPUS ENGINEERING CORPORATION, , Park Ave., Worcester, Mass. Sales Offices in *Thomas' Register*.

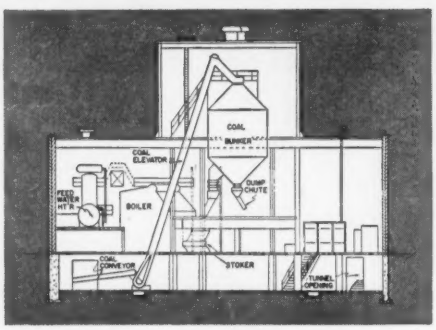
COPPUS
STEAM TURBINES

For more facts circle 882 on Reader Service card, p 227





Entrance to unusual "little Pentagon" structure. This shape gives maximum space utilization and allows one-man central control of all boilers. Construction provides comfortably for three 31,000 lb/hr boilers and allows for two similar units in the future, within 7,000 sq. ft.



Elevation shows how coal moves from incoming conveyor by 25 ton/hr. Stephens-Adamson Redler elevator to overhead bunker (capacity 125 tons). Coal feeds from here to scales, then directly into stokers. Bunker and scales by Beaumont Birch Co.

Coal is brought in by rail and unloaded into track hopper. From here, a Stephens-Adamson conveyor carries the coal into the plant and internal coal handling system.

Hospital cures fuel ills with "little Pentagon"

Richmond State Hospital burns coal for economy and availability in modern pentagonal power plant

After a power system failure at the Richmond State Hospital, Richmond, Ind., the administration conducted an engineering survey of its steam-generating operation. Over-age equipment indicated the need for entirely new facilities. The shape of the boiler room site prompted the unconventional pentagonal installation for best possible adaptation of space to present and future needs. *Economy* and *availability* dictated the choice of coal as the fuel.

Today a new power plant—designed by Fleck, Quebe and Reid, Indianapolis, with F. B. Morse, of Purdue University—burns coal in a completely modern, automatic operation. The outstanding features of this compact installation are its high combustion efficiency, minimum manpower requirements and continuing ease of maintenance.

Coal is lowest cost fuel

Today, *when the annual cost of fuel often equals the original cost of the boilers,* you should know that bituminous coal is the lowest cost fuel in most industrial areas. And modern coal-burning equipment gives you 15% to 50% *more* steam per dollar, while automatic operation trims labor costs and eliminates smoke problems. What's more, tremendous coal reserves and mechanized mining procedures assure you a constantly plentiful supply of coal at stable prices.

Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you with the efficiency and economy of coal.

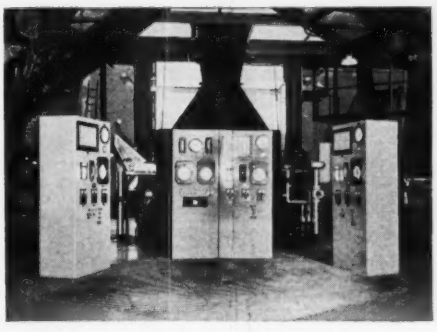
Technical advisory service

To help you with fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to address below or send coupon. Ask also for case histories booklet, complete with data sheets. You'll find them informative.

BITUMINOUS COAL INSTITUTE

Department P-10, Southern Building, Washington 5, D. C.

See our listing in *Sweet's*



Shown are three Henry Vogt boilers, fed by Laclede chain grate stokers, with individual control panels. Controls are pneumatic type, by Copes Vulcan. From boilers, ashes are moved pneumatically by United Conveyor Ash handling system to silo for disposal.

SEND COUPON FOR NEW BCI PUBLICATIONS. Guide Specifications, with complete equipment criteria and boiler room plans:

BITUMINOUS COAL INSTITUTE
Southern Building, Washington 5, D. C. P-10

Gentlemen—please send me:

☐ GS-1 (low-pressure heating plant, screw-type underfeed stoker); ☐ GS-2 (high-pressure heating and/or process plant, ram-type underfeed stoker); ☐ GS-3 (automatic package boiler for heating and process plants). ☐ Case histories on larger plants.

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For more facts circle 883 on Reader Service card, p 227

circle 884 on Reader Service card for following ad ➤

3 NEW G-E MOTORS AND 42 QUALITY IMPROVEMENTS

A family appearance in power station motors and 42 basic design improvements are now available from General Electric. The three new enclosures shown here enable electric utilities to select power station motors with the same modern appearance. And all of these new motors contain the same advanced features, painstakingly engineered to meet electric utility standards of reliability.

Among the 42 quality improvements available on all G-E boiler feed pump motors, are:

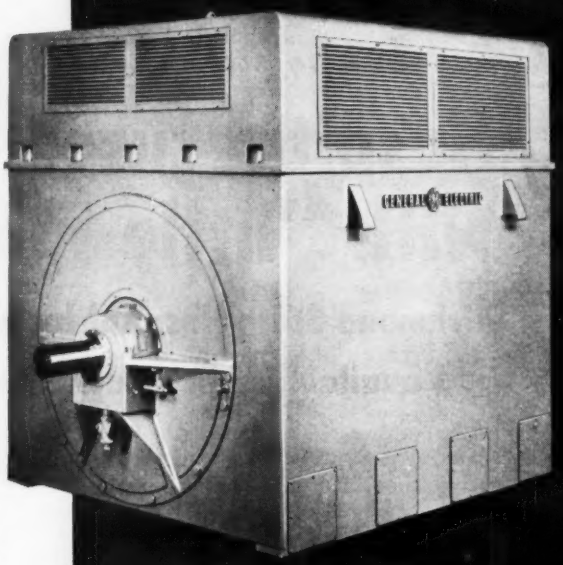
- **Polyseal* insulation system**—sealed against moisture; resists fly ash, most other abrasives.
- **Patented tying system**—heat hardened Permafil glass rovings hold end turns of form wound coils in a vise-like grip for maximum support.
- **Rugged frames**—provide added rigidity and strength required for power station service.
- **Extremely low noise level**—now possible with proven acoustic treatment.
- **Stator connections**—all brazed for more uniform strength, reliability.
- **Controlled slot wedging**—provides tight, stable fit, virtually eliminates coil looseness and resultant wear.

FOR THE COMPLETE STORY on G.E.'s 3 new power station motors and 42 quality improvements, contact your G-E Apparatus Sales engineer or write Section 884-3, General Electric Co., Schenectady 5, New York.

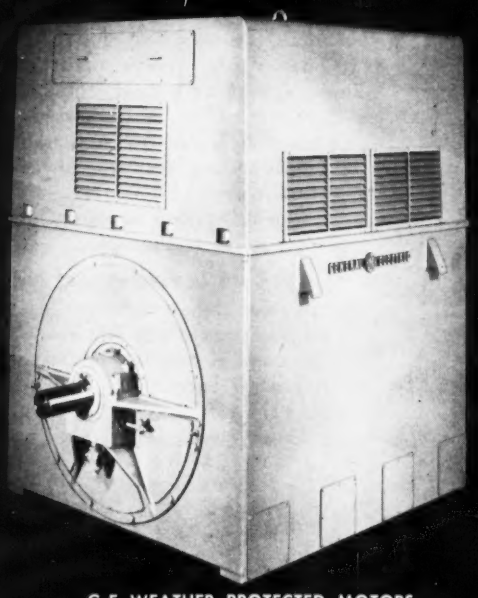
*Trademark of General Electric Co.

Progress Is Our Most Important Product

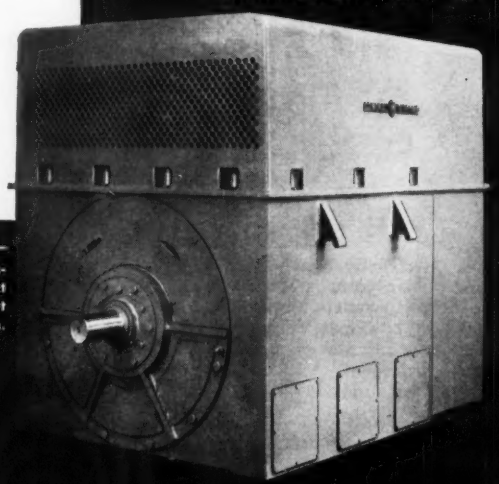
GENERAL ELECTRIC



BOILER FEED PUMP MOTORS—
Large 2-pole drippproof motors are acoustically treated for quiet operation—give long, reliable service.



G-E WEATHER PROTECTED MOTORS—
give better protection against rain, snow—even hurricanes—exceed NEMA Type II definition.



G-E TUBE-COOLED TEFC MOTORS—
are designed for easy disassembly, maintenance and inspection; computers select optimum number, size and arrangement of tubes for most effective ventilation.

another G-E PROJECT '8000' development

PROJECT '8000'—
a major General Electric program of research, product redesign, advanced manufacturing and improved customer service on a-c motors 150- to 6000-hp.

Your service center for FREE data

Either of the no-postage Reader Service cards below and p 227B will bring you FREE valuable additional information on any item listed in the Equipment and Design Aids Roundup and on any advertised product appearing in this issue. Here's all you need to do to get this information:

- **Study New Equipment** described in the 37-p roundup starting on p 229. Circle numbers on card corresponding to items listed
- **Check Design Aids** surveyed, beginning on p 229. To get your personal copies use the card below
- **Read advertisements** and note number listed under each ad. Circle ad numbers on card for complete details
- **Print your name and company on front of card**

October 1959 issue — This card void after April 1, 1960

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NEW PRODUCTS reviewed, starting on p 229

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
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DESIGN AIDS listed, starting on p 229

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Engineer's bookshelf... A selection of late publications

Heat-transfer book may set industry standard

Heat Exchangers. *Patterson-Kelley Company, East Stroudsburg, Pa.*

This guide to the application of shell and tube heat-transfer equipment is an attempt to establish an industry-wide basis for standardization of heat-exchanger mechanical design.

Booklet lists standardized component designations of shapes for front heads, shell sections and rear heads. A wide variety of designs for each component permits use of standard parts in most applications.

Heat Exchangers is designed to fill the special needs of heat-transfer engineers and specification writers for heat-exchange equipment. Symbol designations simplify component description and cut chance of errors in specifying equipment.

Sections dealing with fundamental principles and economic considerations in heat-exchanger application combine with standard inquiry and spec sheets to add to the value of the book. Sections are serially numbered to permit distribution and insertion of supplementary pages as issued.

Qualified heat-transfer engineers and specifications writers may obtain *Heat Exchangers* by writing to publisher on their company letterhead, stating position and responsibilities.

Electrical Equipment Manual. *By J F McPartland and W J Novak. 176 pp, illust, $4.00. Electric-Wholesaling —A McGraw-Hill Publication, 330 W 42nd St, New York 36, N. Y.*

This book gives you a quick look at a wide variety of equipment. Descriptions are brief, simple and nicely illustrated. Book is most useful to plant electricians and maintenance men, but may also be a handy reference for engineers whose knowledge of electrical equipment is a bit hazy or who would like to review. Equipment and methods described are up to date, of a kind frequently encountered. Among subjects covered are: lamps, air conditioners, industrial electric heaters, motors and generators, sound systems, busways, transformers, rectifiers, wiring devices, relays and pole-line equipment. Illustrations show how to lay out and install equipment as well as explaining how devices operate.

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Electrical Machines, Direct and Alternating Current, second edition. *By Charles S Siskind, Assoc Prof of Electrical Engineering, Purdue University. 563 pp, illust, $8.00. McGraw-Hill Book Company, Inc, 330 W 42nd St, New York 36, N. Y.*

Scope and character of second edition are essentially similar to the first. Treatment is clear and thorough, and book is amply illustrated. Knowledge of calculus is not required. Changes bring book in line with today's electrical practice.

Special attention is given to control methods in the operation of dc and ac motors, including dynamic braking, plugging, regeneration and speed control. A completely new section handles rectifiers, such as copper oxide, selenium, silicon, mercury arc. Each chapter is followed by an enlarged set of questions, problems and answers. Equipment illustrated is up to date and well chosen.

Electric Energy Conversion. *By Y H Ku, ScD, Prof of Electrical Engineering, University of Pennsylvania. 522 pp, illust, $10.00. The Ronald Press Company, 15 E 26th St, New York 10, N. Y.*

Book examines electrical machines from the point of view of energy conversion. Treatment is condensed and theories are developed mathematically. Electrical engineers are given unified approach to theory of electrical machines with emphasis on fundamental physical principles and analytic techniques. Treatment of transient analysis is based on LaPlace transforms so engineers concerned with electrical machines can solve problems with this technique. Some more specialized machines such as metadynes and control-type dc generators also get attention.

Extensive references are provided at the end of each chapter. A 23-page appendix covers various problems.

Symposium on Radioactivity in Industrial Water and Industrial Waste Water. *76 pp, hard cover, 6x9, $2.50. American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.*

Advent of nuclear power has brought new problems to the field of industrial water techniques. Problems in the reactor plant and in associated waste water are discussed, methods of analysis described.

Book should provide interesting up-to-date data for water technologists, utilities engineers. Among the papers included are: "Radioactivity and purity control of APPR primary water"; "Radioactive waste processing control, Shippingport Atomic Power Station"; "Test methods for radioactivity hazards in industrial waters"; "Analysis of radionuclides in aqueous wastes from an "atomic" plant"; "Analysis of environmental samples for radionuclides."

continued

October 1959 issue

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NEW PRODUCTS reviewed, starting on p 229

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
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Thermodynamics. *By G J Van Wylen, Chairman, Dept of Mechanical Engineering, University of Michigan. 567 pp, illust, 6¼x9¼, cloth, $7.95. John Wiley & Sons, 440 Fourth Ave, New York 16, N. Y.*

This new approach to fundamentals of engineering thermodynamics assumes familiarity with basic physics of heat and mechanics, facility with partial differential equations.

Author groups order of treatment somewhat differently from other standard texts. Chapter headings typify book's scope: definitions; properties of a pure substance; work and heat; first law of thermodynamics; second law; entropy; ideal gases; gas mixtures; availability, irreversibility and efficiency; reciprocating machines; power and refrigeration cycles; flow through nozzles and blade passages; equations of state and charts; chemical reactions—combustion; equilibrium; control volume; thermodynamic properties.

Power Plant Theory and Design. *(2nd edition of Steam Power Plants). By P J Potter, Head Professor, Dept of Mechanical Engineering, Alabama Polytechnic Institute. 710 pp, illust, tables, 6¼x9¼, cloth, $10.50. The Ronald Press Company, 15 E 26th St, New York 10, N. Y.*

New chapters on diesel, gas-turbine, hydro and nuclear plants have broadened the scope of this well-known book and led to a title change for the 2nd edition. Attention still focuses on central station steam-electric plants and design.

Book opens with a brief review of types of plants and basic economic principles, then deals with fundamentals of fluid flow, pumps and heat transfer. Turning to the major elements it continues with fuels and combustion, steam generators and heat exchangers that serve the basic steam turbines. After a fast look at steam engines it handles plant heat balances, then plant economics.

Plant Engineering Handbook, second edition. *2150 pp, 6x9, $23.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

Handbook is a compilation of information covering 92 important elements of plant organization, design, construction, operation and maintenance, showing how any industrial plant can be run more efficiently and more economically.

Book gives essentials of good practice in the economic, mechanical, chemical and power areas of modern industrial-plant operation, principles observed by the country's leading firms and methods these companies find effective. Basic treatises on many subjects are included, and you'll find a fund of data, tables, formulas, graphs and quick-reference info.

This second edition has been thoroughly revised and updated: 45 sections of the first edition have been revised, 18 have been deleted and 34 new sections added.

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Air conditioning, heating, refrigeration, ventilation — 230

Electrical generation, transformation, conversion — 232

Electrical distribution and protection — 234

Electrical applications — 236

Heat exchange — 242

Lubrication — 248

Materials handling, storage — 254

Prime movers — 266

Welding — 270

Compressors and accessories — 275

Pumps — 276

Steam generation — 278

Valves, piping, fittings — 281

Mechanical power transmission — 289

Water treatment — 299

Instrumentation — 307

Other power services — 321

A 37-page survey of the latest power-service equipment and design aids

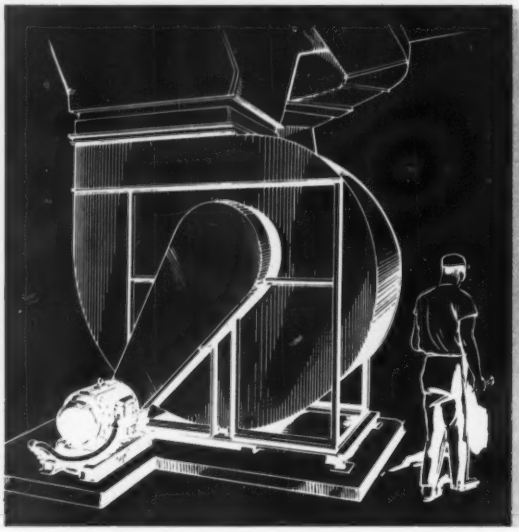
Before you can select specific equipment to fit into your power-service design, you'll need up-to-the-minute knowledge of latest products available. Here we can be of immediate help. As part of our editorial service to the power field, we relentlessly comb the almost endless quantity of new equipment designs and new product literature that comes into the market place, pick out the best of each year's crop.

To refresh your design thinking, we've carefully sifted the wealth of information on tap for the past year, and come up with this survey of equipment and design aids, plus editorial analysis of trends in each type of plant equipment. We hope you find it a valuable guide to plant design in 1960.

Paul Schwabe

Assistant Editor

AIR CONDITIONING, HEATING, REFRIGERATION and VENTILATION



Increased industrial demand for air-conditioning equipment and ventilating systems—all aiming at improved working conditions—shows up in recent equipment developments. Heat pumps in the 500-ton capacity range are now available and packaged installations, consisting of outdoor air unit and instrumented heat pump, cover the small and intermediate capacity range. New absorption units offer even larger unit capacities and improved operating economy over the load range. Resulting first-cost and operating savings make air conditioning economical for plants with 2000+ ton loads. To complement industrial air conditioning, new air-filtering and air-washing units offer complete control of atmospheric conditions throughout the plant.

L. E. Stewart

Assistant Editor

Recent equipment designs: Circle key numbers on Reader Service card, page 227, to get further information

1 **Rough-service** packaged cooling units are built for adaptability and dependability. Originally designed for air-force radomes, they'll run in the tropics, near salt water or in the far north—key parts are corrosion- and fungusproof. Packaged air-conditioning unit and refrigeration unit have glycol, the nonfreeze heat-transfer medium or coolant, traveling in a closed circuit to absorb excess heat. Each unit has three air-conditioning or refrigeration systems—one, two or all three can run at the same time, and they signal their own headaches so inexperienced help can spot the trouble.—Carrier Corp

2 **Packaged water chillers** are ready to tackle air conditioning or industrial cooling. They come in nine sizes from 20 to 125 hp. New feature of the redesigned line is capacity control, actuated by crankcase suction pressure.—American-Standard Industrial Div

3 **Expanded central-station air-conditioner** line boasts high-pressure and capillary models. Units are recommended for static pressures from ¼- to 9-in. wg, deliveries from 800 to 40,000 cfm. The new capillary conditioner has sprays acting on glass-filled cells to produce highly saturated air through evaporation. Cells do double duty as filters for normal quantities of dust. New high-pressure line has oversized shaft, heavy-duty fan and well-supported bearings.—American-Standard Industrial Div

4 **Blow-through dehumidifiers** are designed to meet most stringent requirements of medium- and high-velocity all-air systems in multistory buildings. Sprayed-coil units come in low- and high-pressure models in 127 sizes from 2310 to 45,900 cfm. The heavy-duty casing is built to be air- and watertight. Both ends of cooling coils are sealed inside casing to prevent sweating and dripping.—American-Standard Industrial Div

5 **Packaged cooling towers** are used with commercial and industrial air-conditioning systems and for process water. Designed for greater capacity in less space, the induced-draft towers are made of steel with plastic base coating or of stainless steel. Filling is heart-grade redwood. Model *3208* has 7.5-ton capacity at 75-F wb.—Mason Products, Inc

6 **Industrial heater** has a quiet blower—low noise level suits the units for use in schools and stores as well as general industry. Range is 280,000 Btu per hr and higher. Burners for oil, gas or combination fuel are available—on the combination burners a single switch provides instant changeover.—Lennox Industries Inc

7 **Large hermetic centrifugal** refrigeration machine boosts capacity of line to 1500 tons. Major advantage is reported to be low installation cost per ton of capacity, possible because of minimum electrical service needed, use of a single compressor-motor and starter, good performance characteristics. Hermetic motor is cooled by refrigerant passing around and through windings, plus star-delta starter connections.—Carrier Corporation

8 **Direct-fired heaters** feature a stainless-steel combustion chamber with 4-point floating suspension to allow free movement during heating and cooling cycles. Economizer tubes are installed above combustion chamber, swaged into headers to cut out stresses and buckling. Light or heavy oil, gas or oil-gas burners produce capacities from 400,000 to 3,500,000 Btu.—Arkos Manufacturing Company

9 **Cooling-tower splash bars** are now supported by molded grids fabricated of glass-fiber-reinforced polyester resin. These supports are noncorrosive and immune to rot and decay, according to maker. Per-

manently level installation prevents water channeling and loss of performance. In cross-flow towers these bars are reported to extend service life and reduce maintenance cost—they're standard on firm's cross-flow line.—The Marley Company

10 **Versatile ventilator** does extra duty as a skylight. High-capacity gravity roof ventilator has translucent glass-fiber dampers and gutter to let in plenty of natural light. Fibrous glass is claimed to make parts strong, nonwarping and resistant to damage from fumes and chemicals. With dampers open or closed light is reported to be well diffused, without isolated hot spots and glare. A safety feature: fusible link parts when temperature gets above 212 F, opening dampers to vent fire, smoke and gases.—The Swartwout Company

11 **Rugged roof ventilator** boasts a low profile for easy installation. Low-speed centrifugal type unit has a nonoverloading wheel and streamlined inlet complete with large access door, motor and V-belt drive. Each size is sound-rated for specific building environments. Capacities run from 1120 to 34,440 cfm at free delivery, up to 26,540 cfm at 1-in.-wg static pressure. Ventilator wheel provides true nonoverloading power characteristics—12 large-area die-formed blades mount in backward-inclined position. Cast-iron driving hub is riveted to backplate for quiet, efficient operation. —American-Standard Industrial Div

12 **Wet dust collector** uses hydrostatic concept of collection. A circular venturi introduces mixture of dirty gas and water into a vertical cylinder—cylinder is reported to keep dusty air in cleaning element longer so water and dust particles have a good chance to collide. Then a baffle removes water from the air stream. This unit will also handle floating material.—Fly Ash Arrestor Corporation

13 **Entrainment separator** uses centrifugal force to separate moisture and oil entrained in steam, air or gas. Vapor is directed through an annular passage which increases speed and centrifugal force. Entrained matter clings to outer wall, then drains downward to an automatic trap. Large outlet-chamber entrance is reported to reduce velocity, eliminate re-entrainment problems.—Wright-Austin Company

14 **Parabolic filter** boasts efficiency, good dust-holding capacity and low initial resistance at a modest cost —$1.80 to $2.50 for standard sizes. Unit is engineered for air-conditioning, heating and ventilating systems. Streamlined parabolic shape provides strongest filtering action where dust particles are finest, according to maker.—Arco Manufacturing Corporation

15 **Airfoil** backward-curved blade design, streamlined inlet contour permit continuously smooth flow of air through this heavy-duty fan. High-efficiency units are reported to be suitable for mechanical-draft and other heavy-duty work and in conduit type air-conditioning systems.—Clarage Fan Company

16 **Horizontal air filter** features automatic renewable glass-fiber media, automatic operation. A minimum of maintenance keeps it going, maker claims. Good for limited-headroom installations, horizontal design can be used on existing or new multizone air-conditioning units, heating and ventilating units and industrial heaters. Ten sizes cover 4070 to 39,000 cfm.—American Air Filter Co

17 **Forward-curved** mechanical-draft fans have many blades to provide high air-movement to size ratio. All blades are made of mild or alloy steel. Streamlined inlets direct air into low-peripheral-speed rotor with minimum turbulence, while big inlet boxes reduce entering velocity to cut noise still further.—Chicago Blower Corporation

18 **Duct-fan** speed is adjusted quickly and easily with variable-pitch belt drives. Simple driver-sheave adjustment slows fan, reduces air deliveries up to one-third. You can change your motor to meet changing air-delivery needs with fan in place because components are completely standardized within each size. All belt-drive fans of same diameter use same duct, bearing cover, assembly base.—Hartzell Propeller Fan Co

Free air-conditioning design aids: Circle key numbers on handy Reader Service card, p 227, for your copies

285 **Air-conditioning** certification is discussed in 16-p bulletin. Describes rating tests used in industry program. Air-Conditioning and Refrigeration Institute

286 **Centralized** air conditioning is topic of catalog 7558. Horizontal, vertical and multizone units come in 29 types. Young Radiator Company

287 **Central-station** air conditioners are topic of 76-p catalog 9227. L-p and h-p design features, construction details, cooling and heating coils and accessories are discussed. American - Standard Industrial Div

288 **Vertical and horizontal** draw-through central-station air conditioners are topic of 40-p catalog 1309. Includes tables, charts, dimensional drawings, a sample problem. Clarage Fan Company

289 **Refrigeration** compressors, heavy - duty 4 - cylinder models, are discussed in 20-p bulletin 651-C. Frick Company

290 **Unit heaters,** horizontal and vertical type, are described in 12-p catalog 1103. Tables list steam, hot-water and sound ratings, dimensions. Clarage Fan Company

291 **Pressure fans** are covered in 20-p booklet 857. Four pages of graphs aid selection. Clarage Fan Co

292 **Cyclone dust collector** is discussed in 20-p bulletin 272B. A 10-page section describes hoppers, precleaners, aftercleaners. American Air Filter Company, Inc

293 **Dampers** and damper operators are listed in catalog C101-3. Minneapolis - Honeywell Regulator Co, Industrial Div

294 **Sound ratings,** other buyer info for gas-fired unit heaters are included in 8-p catalog 58. Grinnell Corporation

295 **Electric heaters** and heating devices are covered in 52-p catalog GEC-10051. Gives photos, diagrams, specs and pricing info. General Electric Company

296 **Packaged water chillers** for cooling and air conditioning are

covered in 16-p brochure 8325. American Standard Industrial Div

297 **Heating** and ventilating units of 600- to 73,000-cfm capacity are covered in 20-p bulletin 910. Gives filter, coil, fan-capacity data. American Air Filter Company, Inc

298 **Tubeaxial fans'** performance and dimension specs are subject of 8-p catalog 1110-B. Westinghouse Electric Corporation, Sturtevant Div

299 **Axial-flow fans** for corrosive atmospheres or high temperatures are topic of 16-p application guide AM-1001. Westinghouse Electric Corp, Sturtevant Div

300 **High-efficiency filters** are discussed in 8-p bulletin 238. Shows media and full assemblies. American Air Filter Co

301 **Mechanical-draft fans** are discussed in 8-p brochure 1361. Centrifugal units handle abrasive gases at high temperatures. Westinghouse Electric Corporation, Sturtevant Div

302 **Dust-collector** application handbook, 24 pp, describes dust-producing processes and how to control them. Wheelabrator Corporation

303 **Pressure blowers** with variable hp and flow are shown in 4-p catalog 1210-2. Westinghouse Electric Corp, Sturtevant Div

304 **Electronic air cleaners** are subject of 16-p bulletin 258A. American Air Filter Company, Inc

305 **Hot-water heating** convertors are described in 12-p bulletin 303-A. Patterson-Kelley Co, Inc

306 **Infrared** controlled-area heating is described in 4-p bulletin. Quartz Products Corporation

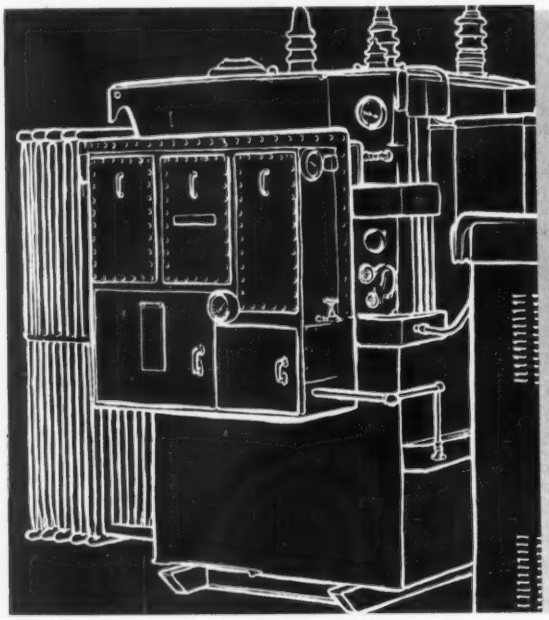
307 **Liquid chillers,** 20- to 180-ton packaged units, are covered in informative 4-p booklet 802-A. Frick Company

308 **Gas-fired unit heaters** are subject of 4-p bulletin GU-100. L J Wing Mfg Co

309 **Electric-heating design** guide is a 33-p booklet. Charts show how to compute heat losses. Westinghouse Electric Corporation

310 **Air-cooled** packaged chillers and remote-condensing-unit assem-

ELECTRICAL GENERATION, TRANSFORMATION and CONVERSION



Silicon diodes continue to find new uses. They've made possible the brushless generator, both as a packaged ac set and as an exciter for large alternators. In latter application brushless machines are being developed in largest ratings. For rectifiers, some manufacturers offer conversion kits to replace selenium and copper-oxide cells now in use. Don't count selenium out of the race, however; latest manufacturing process has markedly improved aging properties of selenium rectifiers. There are still some jobs best handled by this type of rectifier.

Gaseous insulation looks more and more promising for power transformers, although it's still in early development stages. Vapor cooling is another technique which will find definite applications.

Norman Peach

Associate Editor

This year's new equipment: Circle key numbers on Reader Service card, page 227, to get more information

19 **Brushless generator** is latest design for ac power. High-power silicon rectifiers replace the conventional commutator on this model, and there are no slip rings, commutator brushes or slip-ring brushes. Available in ratings from 6.25 to 187 kva at 1200 and 1800 rpm, packaged generators come complete with static voltage regulator, meters.—Electric Machinery Mfg Co

20 **Shorter, streamlined bushless generator** is heart of a 100- to 175-kw 60-cycle 1800-rpm power package. Enclosure gives dripproof protection to generator, exciter, regulator and instrument package—instrument recess also shelters a completely static forced-cooled current-compounded voltage regulator. Switchboard mounts directly on top, keeping down length of cable runs.—Allis-Chalmers Manufacturing Company

21 **Standby diesel generators,** rated 50 to 200 kw, 62.5 to 250 kva, provide emergency power to run automatic heating systems, air conditioners, elevators, motors, lights. Stable operation is established two sec after power failure.—D W Onan & Sons, Inc

22 **Dc generators** for battery charging, testing or operating dc appliances come in sizes from 500 w to 40 kw. Shunt or compound-wound units are available.—Kato Engineering Company

blies are covered in bulletin 8027A. Dunham-Bush Co

311 **Instantaneous heaters** with large steam-inlet area are discussed in 24-p bulletin 304.4K1. A 17-p section covers selection tables, charts, piping diagrams. American-Standard Industrial Div

312 **Sprayed-coil** dehumidifiers, draw-through and blow-through types, are topic of 24-p book 9427. American-Standard Industrial Div

313 **Dust- and fume-control** systems are covered in 52-p catalog. Shows wet, dry, electrical and centrifugal collection and plant installations. The Kirk & Blum Manufacturing Company

314 **Electronic air cleaner** is discussed in 16-p product bulletin 249-A. Details of operation, equipment drawings, specs are given in comprehensive booklet. American Air Filter Co, Inc

315 **Duct fans** with driver sheaves for speed adjustment are featured in 12-p bulletin A-114A. Hartzell Propeller Fan Company

316 **Dynafoil fans** for heavy duty are listed in 8-p bulletin 859. Clarage Fan Company

317 **Centrifugal dust collector** is presented in 8-p bulletin 291A. Includes cutaways and schematics, plus product photos. American Air Filter Company, Inc

318 **Ventilation,** air-conditioning, collection or exhaust systems are covered in 12-p catalog 35-8. Carrier Corporation

319 **Instantaneous - steam - injection** hot-water heater is topic of 12-p bulletin. Operation, applications, engineering data are covered. Pick Mfg Company

320 **Automatic air filter** with renewable media is described in 12-p bulletin 248-C. Explains construction and operation. American Air Filter Co, Inc

321 **Centrifugal roof ventilators** are topic of 8-p brochure 4004. Design features of 13 basic sizes are listed. American Standard Industrial Div

322 **Cooling towers,** natural draft type, are topic of 24-p catalog. Provides illustrations of construction and installation, information on operating features, characteristics. Hamon, Inc

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23 **Substation power transformer** boasts internal tank bracing, central location of accessories in a locked cabinet at eye level. Streamlined appearance, lower maintenance are the results. Standardized-design coreform transformer is available in all ASA standard ratings, from 750 to 10,000 kva, 3 phase, 69 kv and below. The rounded-corner tank is lowered over core and coil assembly and welded at base, so core and coils can be bolted to base for rigidity and untanking height is reduced.—Westinghouse Electric Corporation

24 **Dual-role electric generator** is used as a heavy-duty portable power unit or for standby service. The lightweight self-contained plant is rated 2500 w, comes with a 5-gal fuel tank.—D W Onan & Sons, Inc

25 **Completely portable** 750-w electric generating plant uses a 4-pole single-phase 60-cycle 115-v-ac generator. It's designed for general power use. First production units feature a quick-disconnect receptacle, a voltage pilot light and isolation from vibration and radio noise. Each unit weighs 104 lb.—Jeta, Inc

26 **Silicon-conversion kit** is easily installed to modernize magnesium-copper sulfide and selenium rectifiers. Kit is designed as a direct replacement for existing rectifier stacks—it's said to reduce operating and maintenance costs and improve efficiency up to 50% since silicon has no aging characteristics, can be stored for long periods.—Dresser Electric Company

27 **Forced-oil-cooled power transformers** now come equipped with improved coolers. Oil pumps are relocated at ground level for accessibility and slower, quieter fans move more air. Louvers prevent recirculation by directing air upward.—General Electric Co

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New design aids: **To get your free copies, circle key numbers on Reader Service card. See page 227**

323 **Ac generators** with brushless alternators are listed in 16-p catalog ACG958. Kato Engineering Co

324 **Synchronous - generator** features are topic of 6-p bulletin 05B6139B. Allis-Chalmers Manufacturing Co

325 **Regulator** for direct voltage control of main fields of large alternators and generators is topic of 6-p bulletin 6.04. Electric Regulator Corporation

326 **Motor - generator sets** for frequency converting are subject of 4-p bulletin MG659. Kato Engineering Company

327 **Distribution transformers** are detailed in 28-p catalog 500. Gives specs, operating data for dry type units. Hill Transformer Co, Inc

328 **Mercury-arc** rectifier transformers are subject of 6-p bulletin GEA-6845. General Electric Co

329 **Transformer vapor-cooling** principles and practice are discussed in 8-p booklet B-7602. Westinghouse Electric Corporation

330 **Substation transformers,** single- and 3-phase units up to 10,000 kva, are subject of 8-p booklet CS-701. Kuhlman Electric Co

331 **Sealed dry type transformers,** aluminum - wound lightweight units, are subject of 8-p bulletin GEA-6790. General Electric Co

332 **Dry and liquid-filled** transformers are topic of loose-leaf catalog. Marcus Transformer Co, Inc

333 **Transformers,** open dry type with inorganic insulation, are described in 8-p bulletin GEA-6668A. General Electric Company

334 **Substation** transformers rated single phase, 500 kva, 15 kv and below are topic of 8-p book GEA-5452A. General Electric Co

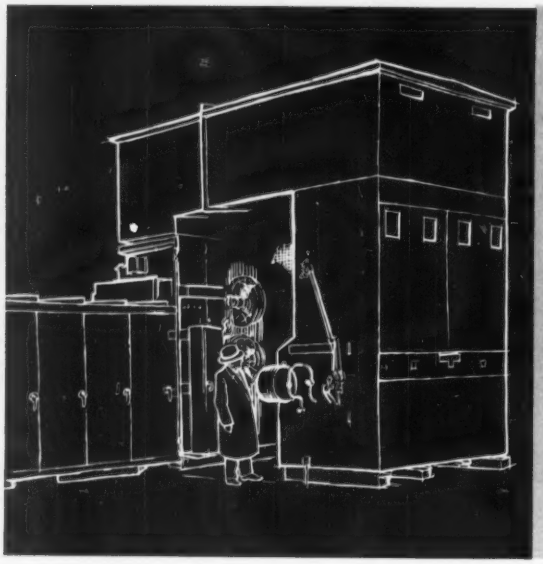
335 **Phase-isolated** load tap changing transformers are covered in 20-p booklet. Gives design, construction details. McGraw-Edison Co, Pennsylvania Transformer Div

336 **Pumpless mercury-arc** rectifiers are described in 12-p bulletin GEA-6848 — ratings range from 750 kw, 250 v to 5000 kw, 850 v. General Electric Company

337 **Rectifier equipments,** pumpless mercury-arc type, are discussed in 12-p bulletin GEA-6849. General Electric Company

338 **Selenium rectifiers** for ac to dc conversion are covered in 10-p catalog. Data and specs are given for 1-sq-in. to 12x16-in. units. Syntron Company

ELECTRICAL DISTRIBUTION and PROTECTION



How to protect growing loads with ever-bigger short-circuit interrupting needs is problem that spurred designers to fashion better lines of switchgear. For high-voltage main-substation protection oil circuit breakers have been improved, including a new look for single-tank units. For larger plants, new air-blast breakers may ease space and weight problems.

Distribution methods have received some refinements to improve performance and make installation easier. Conduit is offered in "pliable" form—tubes made of layers of continuous metal. Isolated-phase bus comes in larger sizes, more convenient sections, and can include disconnecting switch.

Norman Peach

Associate Editor

New equipment designs: Circle key numbers on Reader Service card, page 227, to get further information

28 **Electrochemical-relay** static switch can switch and modulate almost any amount of ac endlessly and continuously, without wear, disintegration or loss of efficiency. There are no moving parts or magnetic coils. Small energy stimulus, applied through a grid element, changes surfaces of two load-connected electrodes to conductive state so ac can flow. Self-energized excitation uses two diodes, which can be small because they handle only control current. Present rating is 70 v. Unit is designed to tackle high-power circuit control, with potential applications including circuit breakers, regulators, time delays and proximity switches.—Ovitron Corporation

29 **Electrical-distribution system** promises total safety. New concept completely isolates personnel from live parts and accidental electrical contact—current-carrying parts are never accessible during installation or operation. Unique protective feature is a "safety-slide" opening and retractable contact. Safety slide covers bus bars and can't be opened until plug-in branch circuit unit is installed on busway. Once plug-in device is installed, interlocks prevent removal. Compact subdistribution centers receive various plug-in units—combinations of fuses, switches, air circuit breakers, motor controls. Live power and plug-in convenience are brought right down to the working level with perfect safety, according to manufacturer.—Electric Distribution Products, Inc

30 **Universal current-limiting fuse** takes care of most indoor potential transformer needs at 14.4 kv and below. It fits all mountings, is not downward-voltage-critical. Any system voltage down to 2.4 kv is handled without impairment of interrupting ability and without inducing excessive transient overvoltages during interruption, manufacturer reports.—S & C Electric Co

31 **Lightning arresters** feature low-discharge characteristics, low-impulse sparkover and high-surge capacity in excess of 100,000 amp. They protect electric-distribution apparatus. Porcelain housing contains a high-strength glaze for greater cantilever strength; deeper-dish porcelain skirts resist contamination. Type *IVS* arresters are rated 3 to 121 kv.—Westinghouse Electric Corporation

32 **Visible-break circuit breakers** give maximum personnel safety: you can check disconnect contacts through opening in side of enclosure, then withdraw breaker to disconnect position without removing front cover. The individually enclosed breakers, designed for industrial plants, are rated 600 v in 225-, 600- and 1600-amp frame sizes.—I-T-E Circuit Breaker Co

33 **Remote circuit breaker** is used with various automatic controls for multiple-circuit mixed-load duty. Solenoid-operated units are used with limited-duty motor starters, automatic lighting controls, remote-control main service switches. Capacities are 0 to 50 and 50 to 100 amp at 240-, 480- and 600-v ac, 125- and 250-v dc, with interrupting capacities up to 10,000-amp rms.—Lake Shore Electric Corporation

34 **Outdoor metalclad switchgear** has a shelter-work area built in. Standard 3-ft sections make up a 9-ft addition giving space for station control batteries, tools, storage—location of control batteries near breakers eliminates conduit runs, reduces voltage drops.—Westinghouse Electric Corporation

35 **Remote-control breaker operator** can be mounted on any of company's existing molded-case breakers without removing them from service. Unit adds only 6 in. to breaker's depth. Motor-operated mechanism pro-

vides positive remote electrical actuation in continuous current ratings from 70 to 800 amp and voltages up to 600-v ac and 250-v dc. Features are high-speed operation, safe emergency manual operation, easy access to instantaneous trip adjustments, simple installation.—I-T-E Circuit Breaker Company

36 **Safety switch** using quick-make quick-break principle is rated from 400 through 1200 amp, has 100,000-amp interrupting capacity with current-limiting fuses. Switch uses contact-operating mechanisms of circuit breakers, but adds a set of fuse holders, omits thermal-magnetic trip.—Federal Pacific Electric Company

37 **Current-carrying capacity** of 12,000 amp is feature of isolated phase bus. A 20½-in. round aluminum conductor is housed in 35-in. nonmagnetic aluminum. Tests indicate that this bus design can carry even higher current with no major heating difficulties.—I-T-E Circuit Breaker Company

38 **Pliable electrical conduit** has tubes made of layers of continuous metal to give your cables maximum protection. The conduit can be set and bent to negotiate corners and curves. After bending it remains almost rigid. It's pressure-sealed to keep out oil and water. —Gemmer Manufacturing Company, Kopex Div

39 **Shallow-depth** distribution switchboards claim versatility, flexibility, compactness. This centralized equipment was developed for medium-sized commercial and industrial buildings. Rated up to 600-v ac, 250-v dc, switchboards are only 14-in. deep. They can be fitted with interchangeable distribution and control units of modular construction: Type AB circuit breakers, fusible switches, magnetic and manual motor starters.—Federal Pacific Electric Company

40 **Pre-engineered substations** for stepping down primary voltages package both transformer and its primary protective and secondary distribution devices. Extended line offers units in ratings from 45 to 2000 kva for stepping down primary voltages from 2.4 through 13.8 kv to 208/120 through 600 v.—I-T-E Circuit Breaker Company

41 **Isolated-phase bus** needs no pressure relief. Made of a cylinder rolled from a single sheet of aluminum, it has round corners, single insulators at each conductor support station. Sealer type and closed-cell neoprene sponge-rubber gaskets keep out moisture. Ratings available are 14.4, 23 and 34.5 kv, 1200 to 20,000 amp.—General Electric Company

42 **High-voltage switch** is completely enclosed in a section of isolated-phase bus, so it takes no extra room. Designed to save space in crowded city locations, switches let you build vertically into unused space rather than expanding horizontally. Completely metal-enclosed equipment also features reliability: faults are limited to phase-to-ground types, and no live parts are exposed to endanger personnel. Units can be built in ratings of 69 to 230 kv.—I-T-E Circuit Breaker Co

43 **Zip-on high-temperature cable jacket** withstands 2000-F continuous operating temperature and up to 3000 F for brief periods. Its made of aluminized reflective asbestos fiber, closed by a plastic or metal zipper track stitched to the fiber with Teflon thread. ID's run from ⅜ in. up.—The Zippertubing Company

Recent design aids: To get copies of those you want circle key numbers on Reader Service card, page 227

339 **Metalclad switchgear** operation, characteristics and application are subjects of 40-p bulletin GEA-5664E. Indoor and outdoor units rated 2.4 to 13.8 kw have interrupting capacities of 75 to 100 mva. General Electric Company

340 **Switchgear,** metalclad units rated 4160 v, are covered in 24-p bulletin 2804-1A. Includes indoor, standard and walk-in outdoor types. I-T-E Circuit Breaker Company

341 **Anode switchgear** function and application is discussed in 6-p bulletin GEA-6841. General Electric Company

342 **Horizontal - drawout** metalclad switchgear rated 4.16 kv are described in 12-p bulletin 18B6346C. Allis - Chalmers Manufacturing Company

343 **Neoprene-sheathed** flexible cords and portable cables are subject of 64-p manual 1108. Includes dimensions, engineering info, splicing and terminating instructions. The Okonite Company

344 **Rigid steel conduit** advantages are outlined in 12-p bulletin RCP-940. Describes ½- to 6-in. sizes. Rome Cable Corporation

345 **Metal-enclosed bus** selection is aided by 20-p bulletin 2604-1A. Gives ratings for isolated- and nonsegregated-phase bus. I-T-E Circuit Breaker Company

346 **Electrical metallic tubing** is illustrated, described in 4-p bulletin EMT-958. Walker Brothers

347 **Integral distribution centers** rated 112½ kva and above, liquid filled and 300 kva and above, open and sealed dry are subject of 28-p bulletin GEC-1355A. General Electric Company

348 **Aluminum rigid conduit** is covered in 12-p booklet MU-28. Mechanical and electrical advantages are outlined. Aluminum Company of America

349 **Underfloor duct systems** and their components are topic of 20-p catalog 758. Includes 11 pages of dimensions. Walker Brothers

350 **Conduletes** for corrosive locations are subject of 16-p bulletin 2699. Describes metals and finishes used. Crouse-Hinds Company

351 **Conduit and fittings** are described in 60-p catalog-handbook 485. Shows installations and applications for galvanized conduit and EMT. Technical section includes specs, electrical data. The National Supply Company

352 **Packaged unit substations** in ratings from 45 to 2500 kva are detailed in 16-p bulletin R-5604-1A. I-T-E Circuit Breaker Co

353 **Aluminum conductors'** current-temperature characteristics are described in a 20-p presentation of latest info. Includes graphs, formulas. Aluminum Company of America

354 **Flame-retardant** polyethylene for wire and cable is subject of an informative 12-p technical paper. Rome Cable Corporation

355 **Electrical connectors,** plugs and receptacles in environment - resistant construction are described in 48-p bulletin 2711. Crouse-Hinds Company

356 **Integrated substations** are topic of 8-p bulletin. Diagrams show various arrangements. Moloney Electric Company

357 **Low-voltage distribution** equipment is listed in 84-p catalog GEC - 1100. Includes circuit-breaker load centers, fuse-puller

panels, safety switches. General Electric Company, Distribution Assemblies Dept

358 **Overhead type** primary distribution system is featured in 20-p technical brochure RCP - 790. Rome Cable Corporation

359 **Industrial electrification** system using steel-enclosed 100-amp trolley busway is covered in 44-p bulletin 75. Feedrail Corp

360 **Isolated-phase bus** is detailed in 12-p bulletin GEA6874. General Electric Company

361 **Cable trays** and support systems for cables, wiring and tubing are illustrated and described in 80-p catalog 858. Includes diagrams, installation info and loading charts. P-W Industries, Inc

362 **Paper-insulated power cable** is topic of 152-p manual 1102. Liberally illustrated with photos, charts and diagrams, book divides into five sections: designs and applications; weights and dimensions; formulas, tables and technical info; installation; splicing. The Okonite Company

363 **Circuit breakers** are featured in 8-p selection bulletin S-4261-2B. I-T-E Circuit Breaker Company

364 **Individually enclosed** low-voltage circuit breaker is topic of 8-p bulletin 4261-2B. Ratings are 600-v ac, 250-v dc. I-T-E Circuit Breaker Company

365 **Fuse-fuseholder** combination for protecting fluorescent fixtures is introduced in spec sheet. McGraw-Edison Company, Bussman Manufacturing Div

366 **Shallow-depth switchboards** rated through 2000 amp are covered in 6-p brochure 2015. Federal Pacific Electric Co

367 **Master unit substations** solve protective, transformation and switching problems in industrial and utility power - distribution systems. Engineering, installation, ratings and dimensions are some topics covered in 58-p publication GEA - 3800D. General Electric Company

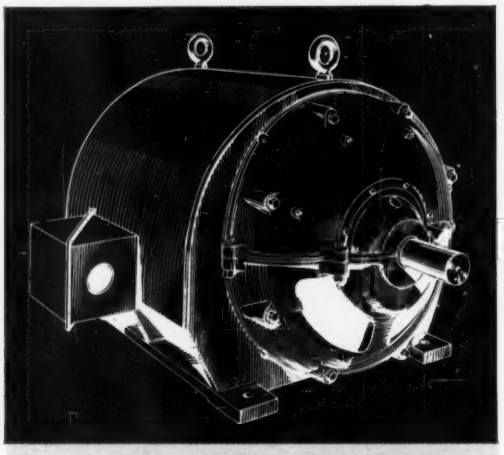
368 **Selection guide** for molded-case breakers and enclosures is an 8-p folder. Master chart groups units by types, current ratings. I-T-E Circuit Breaker Company

369 **Low-voltage power protector** for heavy duty in commercial buildings is detailed in 8-p bulletin GEA-6527. General Electric Co

370 **Explosionproof** electrical equipment design and construction principles are described in 6-p folder 2710. Crouse-Hinds Co

371 **Renewable fuses** are covered in 12-p bulletin 1302. Federal Pacific Electric Company

ELECTRICAL APPLICATION



Electrical insulation for motors is getting a lot of attention—wide variety of materials available can be applied to different service conditions. Encapsulation of motor windings is offered as alternative to totally enclosed frames or for better performance where open frames are normally used.

New, higher lighting levels recommended by Illuminating Engineering Society have spurred developments in high-output fluorescent lamps. This in turn challenges fixture manufacturers to design luminaires for high-quality illumination control. Electroluminescence, not yet a practical lighting source, appears in indicating devices and readout annunciator systems.

Norman Peach

Associate Editor

New equipment designs:

Circle key numbers on Reader Service card, page 227, to get complete product story

44 **Alternating grooves** give a new look to light—new fluorescent lamp reportedly produces 15% more light with only 7% increase in electricity consumed. Increase comes from new tube design using forty 3-in. crescent-shaped grooves alternating on opposite sides of a 96-in. tube. Grooves bring part of the inside coating of phosphor closer to arc stream, where it's stimulated into greater activity. And curved path means that in an 8-ft tube arc stream travels an extra foot—equal to the arc in a conventional 9-ft lamp. Lightness is an additional advantage, since new shape permits use of thinner glass for a 25% weight reduction. Units will operate reliably in existing fixtures. In new installations they'll achieve the full output gain, producing 15,000 lumens at 215 w, according to maker. Price is $6.50 for the 8-ft lamp.—General Electric Company, Large Lamp Dept

45 **Low-resistance ohmmeter** measures resistance values down to one microhm within 2% accuracy. A microhmmeter combines with a transistor type rectifier supplying both a 10-amp dc and a 100-amp dc source. There's also a self-contained 10-amp battery power supply for use where power lines aren't available or are de-energized. Use this test set to check oil and air circuit-breaker contacts and current paths from bushing terminals without disassembly.—J W Dice Company

46 **Electronic millivolt-ammeter** measures and amplifies a wide span of dc currents and voltages, from 10 to 1000 microamp and 1 to 1000 millivolts. Accuracy is reported within 2% on lowest current and potential range, 1% on all others.—Daystrom, Inc, Daystrom-Weston Sales Div

47 **Improved multimeter** features a mirrored scale to eliminate parallax, a dc polarity-reversing switch and wider ac and dc frequency response. This V-O-M boasts sensitivity of 20,000 ohms/v dc and 5000 ohms/v ac.—Precision Apparatus Company, Inc

48 **H-v dielectric test set** is lightweight, gas filled. Rated 50,000-v ac, it features high kva capacity, low waveform distortion. Unit meters directly at h-v output for accuracy. A l-v interconnection cable permits remote operation of the h-v section—you can locate it in a safety enclosure or test cage.—Peschel Electronics, Inc

49 **Dc overpotential tester** comes in two pieces—just stack it up and roll it to the job site. Output is 120,000 v. Its selenium rectifiers stand up to rugged operation, the manufacturer reports. Control section is easily removed from h-v tank section for remote control.—Peschel Electronics, Inc

50 **Electroluminescent lamps** are available as indicator devices for computers, status boards and panels. Flat plates of glass with an electricity-conducting film are coated with special phosphor. When electricity is applied the panel glows. Alphabet or numeral indicators are available—maker says they're easily read even at wide-angle viewing.—Westinghouse Electric Corporation

51 **Low-temperature-curing** silicone resin means electrical shops lacking h-t curing ovens can enter the silicone field. Where conventional varnishes must be set at 200 to 250 C for top performance, this new thermosetting silicone resin cures completely after only 8 to 16 hours in a 150-C oven. You can get Class H impregnation with Class B processing equipment. Or if you have h-t ovens, you can reduce curing time—*XR-622* cures at 250 C in one-fifth the time needed by a conventional varnish, according to manufacturer. Good wettability is an added bonus.—Union Carbide Corporation, Silicones Div

52 **Interchangeable h-v bushings** can be used on transformers or circuit breakers. Units come in eight sizes, and each has a dual current rating, 400/1200 amp from 23 to 69 kv, 800/1600 amp in the 115- to 196-kv range. Current rating is determined by terminal accessories; you convert from one application to the other simply by changing the accessories. Big advantage of interchangeability comes in the shape of spare-bushing inventory savings, and it also means better service in emergencies, lower price. This new bushing will be available on all firm's power transformers.—General Electric Company

53 **Flexible motor-control center** promises simpler maintenance, reduced time for changing individual control units. Standing 60-in. high, basic structure holds five to eight units in 9 1/3 and 14-in. modulars. Units and their multiples can be intermixed to meet any requirements.—Continental Electric Equipment Company

54 **Automatic load-demand system** is used with electric plants up to 4500 w. It starts up plant, turns off the power when it's not needed. Fuel savings can run up to 50%, and life of the generator is increased, maker states.—Pacific Mercury Company

55 **Integrated battery charger** has generator, motor and control panel built into one unit, reportedly saving up to 42% in cost, 34% in floor space. Electrical loads beyond safe capacity of generator are automatically shifted to the battery.—The Electric Storage Battery Company, Exide Industrial Div

56 **Engine starting control** is designed for fully automatic starting and stopping of engine-driven generating sets. It is said to prevent recranking at full engine speed and it responds at 50% of normal battery voltage.—Automatic Switch Company

57 **Sequence controller** achieves automatic control of electric-motor-driven equipment without telephone type relays. Control signals and full motor current are taken through sequence distributor suitable for operation on 440-v 3-phase supply.—Jones, Tate & Co, Ltd

58 **Integral-hp ac motor** comes in sizes from one to 250 hp in your choice of protected, weatherproof, totally enclosed, corrosionproof and explosionproof enclosures. Low-inertia, fast-accelerating rotor is a feature.—Reliance Electric and Engineering Company

59 **High-speed synchronous vertical motor** with double-end ventilation is said to provide maximum cooling efficiency. Sizes are 150 hp and up.—Ideal Electric and Manufacturing Company

60 **Hook-on current transformer** extends applications of firm's recording volt-ammeters, permitting you to make load surveys on insulated or uninsulated distribution lines with voltages to 13,200 v without interrupting service or opening conductors. The 13.2-kv butyl-molded unit weighs 5¼ lb.—General Electric Company

61 **Dc motors** combine fast response, wide speed range and high overload capacity in a light, compact machine. They're available in ratings of 1 to 200 hp, in dripproof and dripproof-guarded enclosures. Improved performance characteristics include fast acceleration, deceleration, reversing and speed changing

because of a low-inertia armature and better commutating ability, maker states.—The Louis Allis Co

62 **Vertical weather-protected motors** are used in heavy-duty industrial applications. They'll perform year-round where continuous operation under severe weather conditions is necessary. One feature is their direct-blow-through passages: high-velocity air passes through motor without entering the active parts.—General Electric Company

63 **Portable kit** tests condition of insulating oil in electrical apparatus easily, quickly and cheaply. Periodic spot checks right at installation site will determine the extent of sludging, indicating when you need a more complete lab evaluation. Kit contains a box of filter paper, medicine droppers and acidity indicator, buffer and polar-compound indicator in polyethylene bottles, plus instructions. Set and steel carrying case cost $15. No technical training is needed to make or evaluate tests, reports the manufacturer.—Allis Chalmers Manufacturing Company

64 **Acetylene-detector kit** spots faults in any power transformer that has a sealed air space above oil level. Kit is a simple form of gas analyzer—gas from transformer is bubbled through solution of ammonia, a brick-red precipitate forms if acetylene is present. Acetylene is one of the first products of decomposition of oil and insulation due to an arc, so its presence means there's been a fault.—Westinghouse Electric Corporation

65 **Dielectric test set** in portable and bench models handles step-voltage resistance, voltage-withstand, breakdown and 1-min resistance tests on insulation in electrical equipment with ratings in 300-, 600- and 2500-v classes. Use it to test rotating electrical machinery, dry type transformers, switchgear, capacitors and insulators. Maximum voltage is 5 kv at 1 ma; maximum output current is 5 ma at up to 2.5 kv.—James G Biddle Co

66 **Lightweight, compact instrument** tests insulating oil in the field. It's used for on-the-spot testing of oil in transformers, h-v capacitors, bushings. Complete portability means h-v breakdown tests can be made wherever electrical equipment is located. Model *4504-A* weighs only 42 lb, costs $725.—Associated Research, Inc

67 **Combination instrument** makes hi-pot or insulation tests. It checks electrical equipment at high voltages necessary to detect insulation weaknesses, shorts or grounds, nondestructively indicates the presence of faults. Engineered for fail-safe operation, tester needs no additional safety cabinets. It measures 7x19x7 in., weighs 22 lb.—Arizona Instrument Corporation

Recent design aids: To get your copies, circle key numbers on handy Reader Service card provided on page 227

372 **Motor controls** are topic of 84-p catalog 14. Photos, wiring diagrams, dimensional drawings illustrate size, weight and ratings info. The Arrow-Hart & Hegeman Electric Company

373 **Control line,** 0 to 4, is featured in convenient 6-p booklet 14B9182. Allis - Chalmers Manufacturing Company

374 **H-v control** for squirrel-cage, synchronous and wound - rotor motors is discussed in 16-p booklet EN-162. Cutler-Hammer Inc

375 **Ac magnetic starters** are topic of 16-p booklet EN-150. Cutler-Hammer Inc

376 **Controllers** for squirrel-cage motors are subject of 4-p bulletin 14B8750. Allis - Chalmers Manufacturing Company

377 **Manual starters** are topic of 8-p bulletin 11B1. Includes dimensions, ratings. Furnas Electric Company

378 **Reduced-voltage starters** are covered in 12-p bulletin 14B8192. Motor control is engineered for centrifugal compressors, pumps, large fans, m-g sets. Allis-Chalmers Manufacturing Company

379 **Motor-control center** is described in 6-p bulletin. Electric Distribution Products, Inc

380 **Quick-selector** motor-control 20-p chart includes info on ratings, sizes, features. Two pages cover heater tables. The Arrow-Hart & Hegemen Electric Company

381 **H-v starters** for squirrel-cage, wound-rotor and synchronous motors are described in 8-p booklet. The Electric Controller & Mfg Co

382 **Synchronous motors** and controls are listed in 28-p brochure B-7292. Discusses types and features, power - factor correction, selection, application. Westinghouse Electric Corporation

383 **Weather-protected motor** is topic of 6-p bulletin 2550. The Louis Allis Co

384 **Motor-application guide** 270-A has 16 pp, lists major factors to consider in choosing polyphase, single-phase or dc motors. Century Electric Company

385 **Ac motor users' guide** B-2103-4 gives selection data on 1- to 200-hp units. The 12-p booklet explains design classes and current and torque values, gives frame-selection tables. Reliance Electric and Engineering Company

386 **Open motors** for applications formerly needing closed designs are covered in 6-p bulletin 05-51B9040. Allis-Chalmers Manufacturing Company

387 **Dripproof pancake motor** is described and illustrated in 4-p bulletin 2150. The Louis Allis Co

388 **Single-phase motors** rated from ¾ to 20 hp are listed in 4-p bulletin 470-B. Robbins & Myers, Inc, Motor Div

389 **Squirrel-cage** induction motors, large high-speed units, are topic of 8-p bulletin 210. The Ideal Electric and Manufacturing Co

390 **Ac and dc standard motors,** special motors, gearmotors and drives are listed in 8-p bulletin 2650. The Louis Allis Co

391 **Epoxy encapsulation** for rewound motors is described in informative 8-p booklet. Westinghouse Electric Corporation

392 **Vertical hollow-shaft motors** are topic of 6-p folder 212. The Ideal Electric and Manufacturing Co

393 **Millivoltmeter** operation principles, specs, features are covered in 28-p catalog C10-1. Minneapolis-Honeywell Regulator Company, Industrial Div

394 **Recording voltmeters** and ammeters are listed in bulletin E-1111. The Bristol Company

395 **Impulse testing** of distribution transformers is described in 4-p brochure. H K Porter Company, Inc, Delta-Star Electric Div

396 **Electrical-measuring** instrument selection and use in experimental labs is covered in 8-p reprint Z-32. Daystrom, Inc, Weston Instruments Div

continued

Superior's Tangent Tube Wall Construction

ENDS CASING CORROSION

The drawing at the right shows the construction of the water wall of a Type D Superior Packaged Boiler.

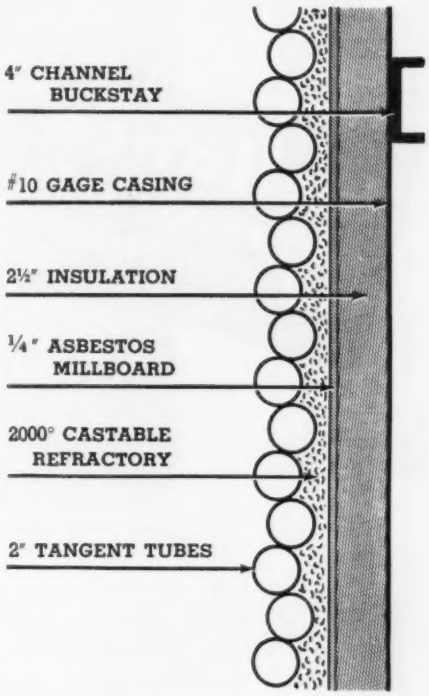
Note that the tubes are in contact with one another along the entire wall. This staggered tangent tube feature, plus a backing of 2000° castable refractory, ¼" asbestos millboard, and 2½" insulation protects the casing from damage due to gas penetration from the positive pressure furnace and its resulting condensation on the inside of the casing.

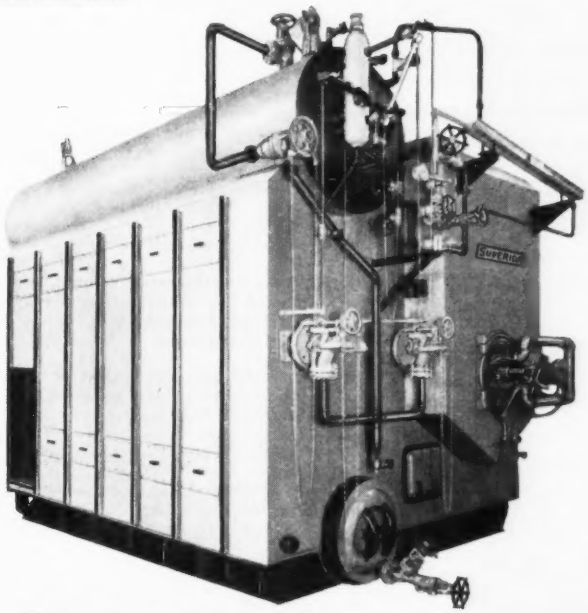
So effective is the cooling surface of these tangent tubes and their backing, that the boiler may be operated without danger to the refractory even with a tube plugged and inoperative.

No finned or bare tube water wall can provide a higher ratio of effective heating surface.

Another important design feature of Type D boilers which contributes to longer boiler life is the inspection openings both top and bottom along the entire boiler tube bank. These inspection openings, shown in the illustration below, eliminate the necessity of burning out the casing in order to inspect rolled tube joints.

Tube holes are serrated to insure protection against caustic embrittlement.





SUPERIOR

TYPE D

PACKAGED BOILER

For installations requiring capacities from 11,000 to 61,000 lbs. of steam per hr. or more, Type D Superior Packaged Boilers provide the ideal answer. True packages, thoroughly engineered, Type D boilers utilize the proven D type tube arrangement. They are built and tested as packages with their own burner equipment, mechanical draft fan, and controls to suit the requirements of the purchaser.

Write today for Bulletin 11D

Specialists in PACKAGED BOILERS... exclusively

SUPERIOR COMBUSTION INDUSTRIES, INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

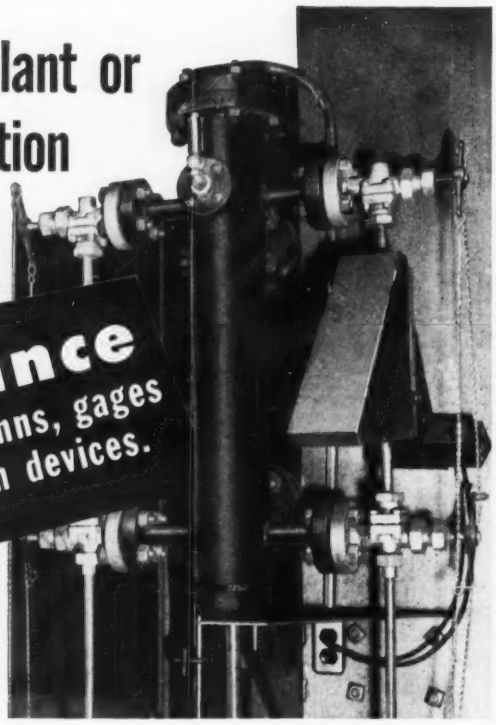
SUPERIOR
PACKAGED BOILERS

For more facts circle 885 on Reader Service card, p 227

For new plant or modernization

...you'll be wise to select...

Reliance
water columns, gages and alarm devices.



Reliance Alarm Water Column, Twin Gages and Trim

Reliance EYE-HYE Remote Gage

Plan wisely for completely safe water level supervision on all boilers, and all water-containing vessels, with rugged, efficient Reliance equipment. This specialized line includes water columns for any type of boiler — any pressure — and complete trim, including various types of gage valves and inserts, direct-to-drum assemblies and illumination; remote reading gages, auxiliary alarms and automatic controls.

Two most valuable *additions* to your present equipment are the EYE-HYE — safe, sure *manometric* remote reading gage — and the several LEVALARMS which provide instant control of alarms, fuel cut-out and pump operation. If not acquainted with them, write for literature.

Reliance LEVALARM Electrode-type control

Known the world over for accuracy, sturdiness and dependability, Reliance equipment brings you the advantages of trouble-free low-maintenance service. For keeping your plant in the best of trim now, or for planning new or revised power facilities, keep posted on the latest in Reliance Boiler Safety Devices.

The Reliance Gauge Column Co.
5902 Carnegie Ave., Cleveland 3, Ohio

BOILER SAFETY DEVICES
Reliance

1884 75th YEAR 1959

Electrical applications

Begins on page 236

397 **Capacitor selection guide** is a handy 6-p folder, GED-3687. Tables cover standard motors, 200 to 4000 v, 2 to 500 hp. General Electric Company

398 **Better elevatoring** is topic of 32-p illustrated booklet. Discusses fundamental considerations in planning vertical transportation systems. Otis Elevator Company

399 **Silicones** to reduce insulator flashovers and cut cleaning time are discussed in 6-p leaflet 4-215. Dow Corning Corporation

400 **Storage-battery facts** are discussed in 32-p booklet. Covers tests, ratings, construction and chemistry. Electric Storage Battery Co, Exide Automotive Div

401 **Rheostats,** tubular slide-wire type, are studied in 12-p bulletin 41. James G Biddle Co

402 **Electrical insulation tapes** and their applications are topics of 32-p booklet E-PCLC. Temperature-limitation chart, test methods are included. Minnesota Mining and Manufacturing Co

403 **Electrical insulating** materials, characteristics and applications are discussed in 12-p booklet GET-2929. General Electric Co

404 **Aluminum electrical application** in building industry is topic of 32-p brochure. Includes info from a survey of 400 contractors, tackles economics of aluminum for conduit, cable, busway, enclosures. Aluminum Co of America

405 **Emergency lighting units** provide instant light in case of power failure—8-p catalog gives details. Electric Cord Company

406 **Industrial lighting** fixtures, color-coded for identification, are subject of 8-p brochure. Edwin F Guth Company

407 **Floodlights** are subject of 184-p catalog 320. "How to select floodlights," "mercury-vapor floodlights" are two of its 14 sections. Crouse-Hinds Company

408 **Vaportight lighting-fixture** line is topic of 12-p catalog. Stonco Electric Products Company

409 **Lighting specs** are detailed in 44-p book. Gives incandescent, mercury-vapor and fluorescent info. RLM Standards Institute

410 **Trouble-shooting** a motor control, preventing refrigerating-plant failures are topics of 12-p reprint. The Ideal Electric & Manufacturing Co

411 **Power capacitors** for h-v applications are discussed in 8-p bulletin GEA-6662A. General Electric Company

For more facts circle 886 on Reader Service card, p 227

Steam costs rising?

LOWER THEM

with a Valley Camp Quality Coal

Each load of Valley Camp Quality Coal is thoroughly washed, sized, and thermally dried. The coal is then mixed to an exact consist according to *your* specification, for maximum efficiency in *your* equipment.

Many consumers are now realizing lowered steam costs with one of these carefully prepared coals. Ask our combustion engineering service to tell you more about them.

THE VALLEY CAMP COAL COMPANY

Western Reserve Building • Cleveland 13, Ohio

SUBSIDIARIES —

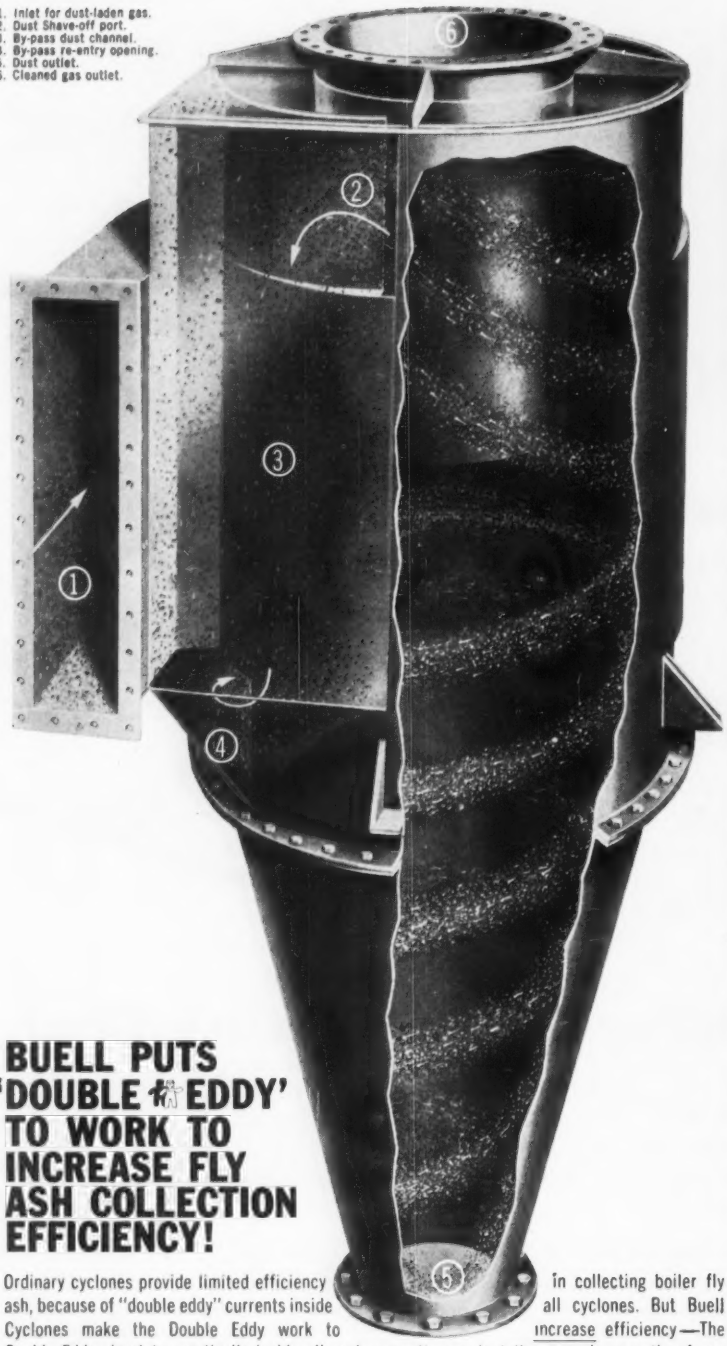
Great Lakes Coal & Dock Co., Milwaukee, Wis. • Great Lakes Coal & Dock Co., St. Paul, Minn. • The Valley Camp Coal Co. of Canada Ltd., Toronto & Fort William, Ont. • Kelley's Creek & Northwestern Railroad Co. • Kelley's Creek Barge Line Inc. • Pennsylvania & West Virginia Supply Corp.

SALES OFFICES —

Philadelphia • Baltimore • Buffalo • Pittsburgh • Wheeling • Cleveland • St. Paul • Cincinnati • New York • Milwaukee • Superior, Wis. • Fort William, Ont. • Toronto, Ont.

For more facts circle 887 on Reader Service card, p 227

1. Inlet for dust-laden gas.
2. Dust Shave-off port.
3. By-pass dust channel.
4. By-pass re-entry opening.
5. Dust outlet.
6. Cleaned gas outlet.



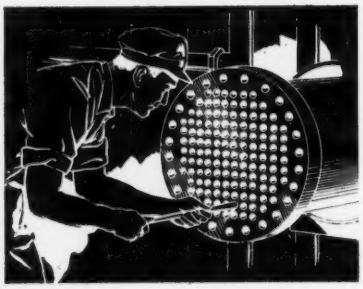
BUELL PUTS 'DOUBLE EDDY' TO WORK TO INCREASE FLY ASH COLLECTION EFFICIENCY!

Ordinary cyclones provide limited efficiency in collecting boiler fly ash, because of "double eddy" currents inside all cyclones. But Buell Cyclones make the Double Eddy work to increase efficiency—The Double Eddy circulates vertically inside all cyclones acting against the normal separating force of the spinning stream of gas and ash. Buell Cyclones have a narrow "Shave-off" port (2) at the top of the casing. This port catches and removes ash trapped in the Double Eddy. It makes the cyclone more efficient instead of less.—Only Buell Cyclones have the Shave-off. And only Buell Cyclones combine this efficiency with large diameter: they will not clog or plug even with loadings up to one pound of ash per cubic foot of gas. No field fitting is needed: they are completely assembled and match-marked before shipment. They can be completely lined, inside and out, against heat, corrosion and abrasion.—For a list of installations near you, a copy of our Catalog 103, or other information, call our nearest representative, listed in the telephone classified directories of most major cities under "Dust Collection Systems". Or write Dept. **50-J,** Buell Engineering Company, Inc., 123 William Street, New York 38, New York. (European Subsidiary: Ambuco Limited, London, England.)

EXPERTS AT DELIVERING EXTRA EFFICIENCY IN DUST RECOVERY SYSTEMS: CYCLONES—"SF" ELECTRIC PRECIPITATORS—COMBINATION SYSTEMS—DRY CLASSIFICATION SYSTEMS.

buell®

HEAT EXCHANGE



Heat exchangers, one of the most vital pieces of equipment for all power services, continue to meet the needs of changing service conditions as shown by the following bulletins. Here you will find information on the wide variety of materials now available for tubing and shells, tools for cleaning, improved designs for greater strength and easier maintenance, new devices for easier tubing operations.

Heat exchangers and accessories listed here range through condensers, feedwater heaters, aftercoolers, chemical process exchangers, hot-water heaters, gas heaters of ceramic materials and oil coolers.

B. G. A. Skrotzki

Associate Editor

NEW HEAT EXCHANGE EQUIPMENT: For complete story, circle key numbers on Reader Service card provided on p 227

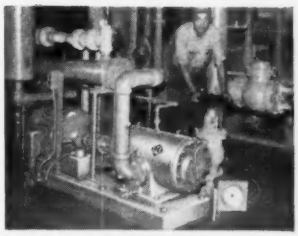
68 **Heat-transfer system** features accurately controlled heat source, constant fluid velocity to guard against overheating damage. Liquid-phase system has finned-tube design with radial fins parallel to heater axis. This is reported to produce maximum heat transfer without return bend obstruction. The fins make possible higher, completely controlled heat output from a shorter tube. Size of system depends on number of heating elements—each is rated 8 kw with design output of 25,000 Btu per hr.—Trent, Inc

69 **Plastic** condenser-tube inserts protect the inlet ends of power-plant steam-condenser tubes. Standard unit fits new tubes, covers critical area exposed to erosion and is streamlined so it won't restrict water flow. Slightly worn tubes are protected by the expanded style, made in graduated sizes to match normal wear

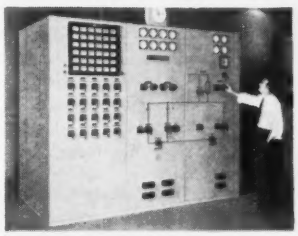
For more facts circle 888 on Reader Service card, p 227

In pace with POWER... **ALLIS-CHALMERS**

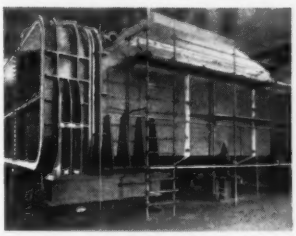
ALLIS-CHALMERS



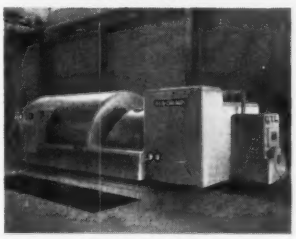
COMPRESSORS



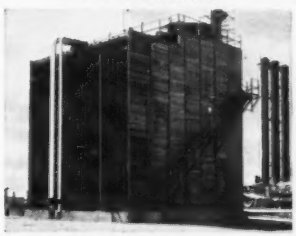
SWITCHGEAR



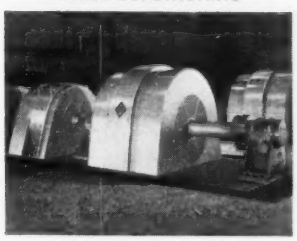
CONDENSERS



STEAM TURBINES



WATER CONDITIONING



MOTOR-GENERATOR SETS

Coordinator for a talent task force...

...he's your Allis-Chalmers man

This task force of experts bulwarks the Allis-Chalmers man. Their purpose: To offer comprehensive, single-source services to help you with preliminary power system planning, erection and operation.

Call the A-C man in *early* . . . to put these researchers, engineers, field service men and other specialists to work on your next power project. He'll make recommendations . . . coordinate schedules of individual products to entire power systems. And you get all the benefits of Allis-Chalmers parts and service programs.

On the following pages, you'll see a few of the power products offered. Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-C ALLIS-CHALMERS

A-1170-PR

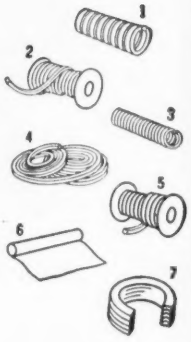
ALLIS-CHALMERS

A mechanical packing problem . . .

HOW AN R/M DISTRIBUTOR PUT AN END TO A DAIRY COMPANY'S TOUGH BOTTLE WASHER PROBLEM

A prominent dairy company once used ordinary braided packings on its bottle washing machines, but they brought a lot of trouble, coming apart because of the solvents, chlorine and detergents used. On the advice of an R/M distributor, the company tried No. 1845 "Versi-Pak,"® one of the R/M Big 7 packings. This entirely solved the problem. Bottling machines are now repacked two or three times a year where previously it was necessary to repack weekly.

You can enjoy the same kind of sure, economical results by getting in touch with your nearby R/M packing distributor. Not only will he help you reduce your packing inventory, but he will show you how the Big 7 plan makes ordering easier, makes delivery faster. Write for his name and address today.



THE BIG 7 PACKING TYPES

R/M's BIG 7 PACKING TYPES MEET 95% OF ALL PACKING NEEDS

R/M

BIG 7 PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
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RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics
Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings
Brake Blocks • Clutch Facings • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

Heat exchange

Begins on page 242

pattern. You push the polyethylene insert into tube by hand, then tap it home with a mallet to insure a tight fit.—Tennant Development Corporation

70 **Cleaning, descaling air gun** has a set of rapidly reciprocating steel needles. Needles strike surface being worked, knocking off rust, scale and dirt. Cleaning process won't stir up much dust, and the piston operates on normal air pressure. You can get nonsparking needles for cleaning in dangerous areas.—The Marindus Company

71 **High - temperature ceramic** can withstand 1800 F with virtually no thermal expansion, operates continuously at 1290 F. Extremely thin-walled ceramics have been formed into lightweight honeycomb structures. Suggested applications include gaseous heat exchangers, catalyst supports and structural materials for h-t use.—Corning Glass Works

72 **Remote air-cooled condenser** has compressor, receiver, electrical controls and other refrigeration accessories mounted within its casing. Five models are rated 10 to 30 tons. Single and dual units are made.—Dunham-Bush Inc

73 **Blower-type condenser** has low silhouette. Roof installations are inconspicuous, and minimum space is needed for a ceiling-suspension installation. When equipped with optional accessories, the air-cooled unit will condense refrigerant in addition to its heating and ventilating duties.—McQuay, Inc

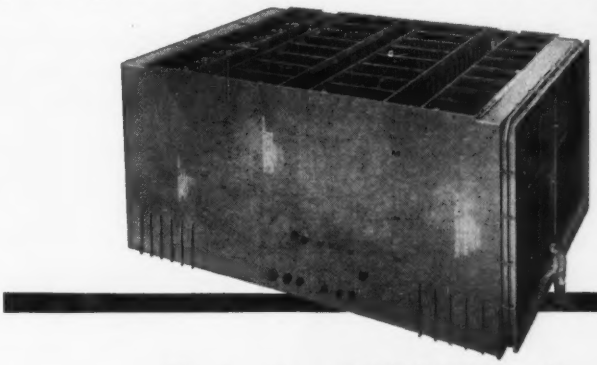
74 **Plastic tube pilots** are used to speed assembly of tubular equipment by guiding heat-exchanger and boiler tube through tube sheets, baffles and support plates. This protects tube ends, and you won't have to fish for tubes through misaligned holes.—Thomas C Wilson, Inc

75 **High-pressure closure** design has operating advantages for feedwater heaters, other h-p, h-t exchangers produced by company. Hydrostatic load is transmitted directly to channel cover to be carried by heavy buttress engagements.—American - Standard Industrial Div

continued

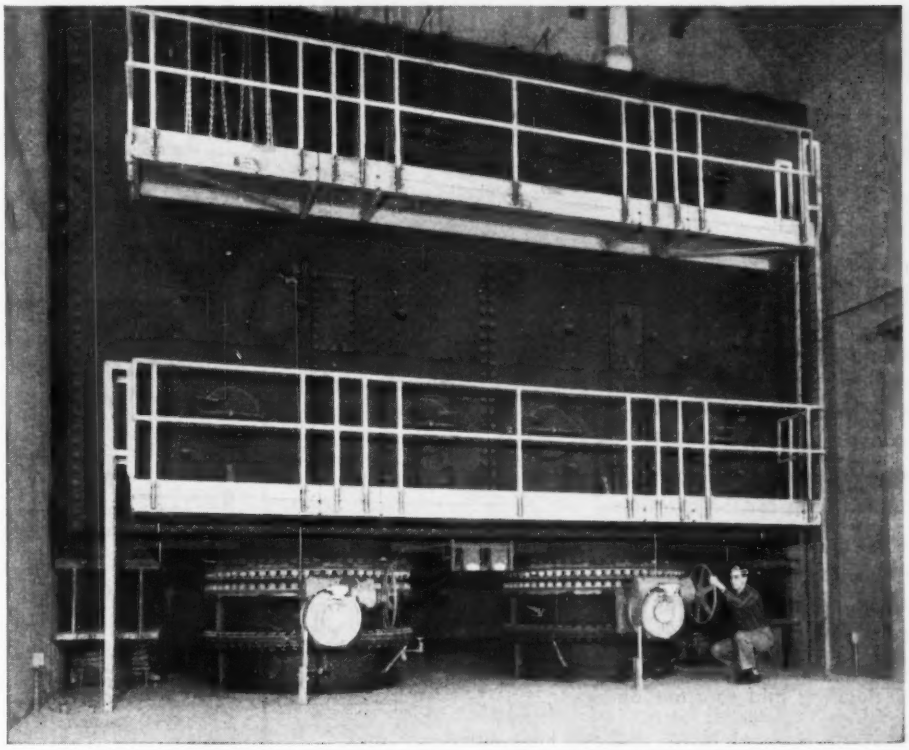
ALLIS-CHALMERS

In pace with POWER... ALLIS-CHALMERS



Plan to stay ahead... MODERNIZE!

Today's BIGGEST Condenser



200,000-square-foot condenser now in operation at Fisk Station of Commonwealth Edison

Some man-sized problems were presented by this unit... not the least of which were shipping and erection. Special Allis-Chalmers well-center cars permitted shipment of the entire shell in only four sections. Special alignment techniques developed by A-C cut installation time.

Today it serves a 327-mw Allis-Chalmers steam turbine generator. Note the compact, space saving rectangular shape pioneered by Allis-Chalmers and made practical by the A-C guided-flow condenser design.

For help on your condenser problems, large or small, contact your nearby A-C office or Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-C ALLIS-CHALMERS

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For MOST ECONOMICAL Cost-Per-Ton SERVICE

Use *Webster* Series 32 IDLERS

Quality-designed and quality-controlled for perfect and permanent roll alignment, economical operation, and minimum maintenance. Your coal-handling system can be improved with these WEBSTER features:

- **Heavy malleable iron roll ends provide rigid, perfectly aligned seats for the bearings.**
- **Strong inner steel tube connects the roll ends and provides grease reservoir for bearings.**
- **Rounded edges of the balanced steel rolls lock in the cast ends and protect the belt.**
- **Timken tapered roller bearings are oversize to meet overloading and constant operation.**
- **Labyrinth seals of metal and felt keep grease in and dirt out.**
- **Rolls easily removed. All parts interchangeable.**
- **Rigid malleable iron supporting brackets.**

You will be pleased with WEBSTER engineering and product service. Let us know your requirements.

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DEPT. P-109, TIFFIN, OHIO

BULK MATERIALS HANDLING EQUIPMENT

SINCE WM 1876

Offices in All Principal Cities

Heat exchange

Begins on page 242

HEAT EXCHANGE DESIGN AIDS: For those you want, circle key numbers on Reader Service card, p 227

412 **Admiralty type tubes** with 13% increase in outside surface area are detailed in 24-p catalog. Lists data for integrally finned tubes. Calumet & Hecla, Inc, Wolverine Tube Div

413 **Carburetor type desuperheater** is described in 4-p bulletin 1056. Blaw-Knox Company, Copes-Vulcan Div

414 **Bi-metal tubes** to solve heat-exchanger and condenser corrosion problems are described in 24-p publication. Bridgeport Brass Co

415 **Using aluminum** in heat-exchanger fabrication is described in 16-p bulletin 732-1-1. Reynolds Metals Company

416 **Feedwater heaters** for bleed-steam to feedwater heat transfer are topic of 4-p catalog M-582. Southwestern Engineering Co

417 **Stainless-steel exchangers** for production, pilot-plant applications are described in 4-p bulletin 301.6K1. American-Standard Industrial Div

418 **Plastic tube protectors** for condensers and heat exchangers are introduced in 4-p bulletin P-335. Crane Packing Company

419 **Chemical-industry** heat exchangers are topic of 8-p bulletin 302.5K1. American-Standard Industrial Div

420 **Pipeline aftercoolers** are covered in 8-p bulletin 302.6K1. American-Standard Industrial Div

421 **Pressure vessels,** heat exchangers for process and power industries are listed in 16-p catalog M581. Southwestern Engineering Company

422 **Cleanable shell and tube** condensers are subject of 16-p catalog 8044. Dunham-Bush Co

423 **Redesigned h-p closures** for feedwater heaters, other h-p, h-t exchangers are discussed in 4-p bulletin 201.1K1. American-Standard Industrial Div

424 **Condensers,** multipass shell-and-tube type, are topic of 12-p bulletin 232-J. Frick Company

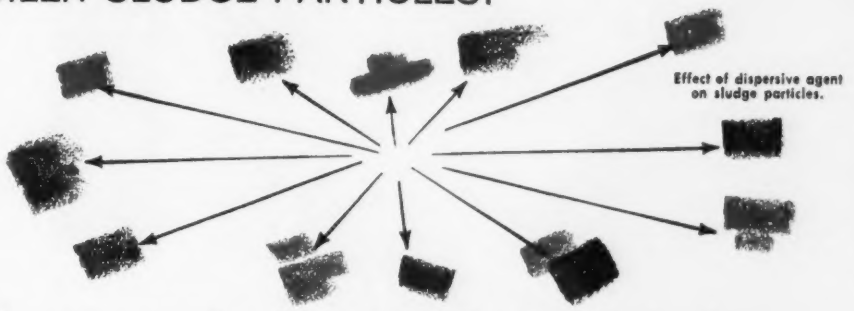
425 **Heat exchangers** are featured in 20-p bulletin B-20. Mechanical design info and thermal rating tables provide easy selection. Struthers Wells Corporation

426 **Heating coils** are covered in comprehensive 30-p bulletin. Specs, dimensional data, surface charts, diagrams tell the story. American Air Filter Company, Inc

ALLIS-CHALMERS

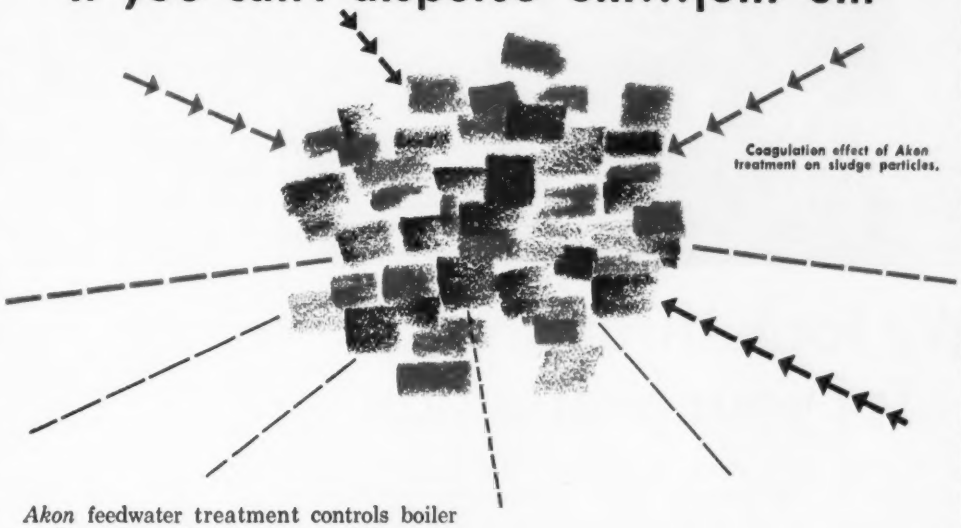
In pace with POWER... ALLIS-CHALMERS

BOILER SLUDGE PARTICLES:



Effect of dispersive agent on sludge particles.

If you can't disperse 'em...join 'em



Coagulation effect of *Akon* treatment on sludge particles.

Akon feedwater treatment controls boiler sludges where dispersive agents fail or lose their original effectiveness.

Coagulating action of *Akon* treatment takes sludge particles out of circulation by forming fluffy, *nonadherent* flocs. These flocs are readily discharged with less blowdown than otherwise required — save fuel, water and chemicals.

More advantages of this process: Eliminates dissolved oxygen by scavenging action to prevent corrosion; permits operation at lower alkalinities; reduces tendency for carryover with no decomposition products.

To cut your boiler operating costs and protect your equipment investment now and for years to come, specify Allis-Chalmers feedwater treatment.

Akon is an Allis-Chalmers trademark.

Bulletin 2887408 illustrates and describes *Akon* treatment. Bulletin 28X7731 provides correct procedures for boiler cycle blowdown.

Mail coupon below for helpful facts on *Akon* treatment and blowdown —

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Gentlemen:
Please send me the bulletins I have checked below:
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A-1153

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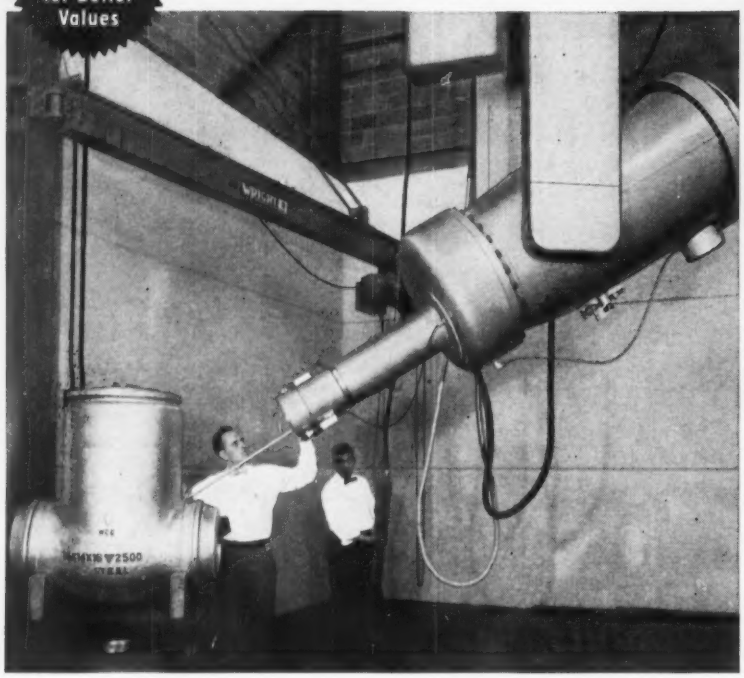


We look thru steel for your protection

• The 2 million volt Van de Graaff radiographic X-Ray generator, shown above, was purchased by R-P&C to provide the positive Quality Control vital to the production of High Pressure Valves and Castings.

Supplemented with a 10 Curie Source of Cobalt 60, under A.E.C. license, this equipment is housed in a special building with walls of dense concrete 48 inches thick, necessary to contain the radiation.

Constant increase in Heat Temperatures and Pressures to which valves and castings are subjected, make relatively minor internal defects critical in many installations. Therefore, use of this X-Ray equipment is now an integral part of our inspection procedures. It offers another assurance of superior R-P&C valve quality.

Regardless of the severity of your service conditions, you can safely rely on the Quality and Dependability of R-P&C Valves. Your R-P&C distributor can supply you promptly with any of these valves including gate, globe, angle and check valves in bronze, electric furnace iron and cast steel, and forged steel; all in a wide range of sizes, styles and pressure classes. R-P&C also offers specialties such as Lubrotite gate valves, bar stock valves, asbestos packed cocks, cast steel fittings and pressure-seal cast steel valves.

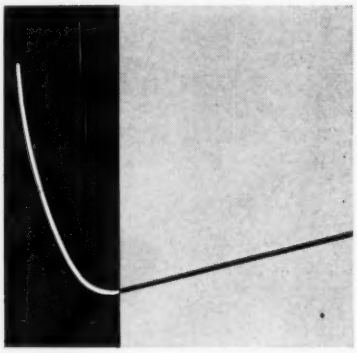
R-P&C VALVES

ACCO

R-P&C Valve Division, American Chain & Cable Company, Inc.

Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

LUBRICATION



One common ground for most of the items below is the fact that they are concerned, directly or indirectly, with boundary lubrication. The classical relationship shown by the curve, above, puts this boundary or thin-film region to the left of the minimum friction point, the lowest point on the curve.

Growing interest in this general area stems from wider recognition of the long-known fact that thin-film lubrication exists in practically all equipment on startup, and in the majority of bearings during normal operation. Remember that bearings working in this thin-film region will experience some metal-to-metal contact. Both lubricant supplier and bearing manufacturer are working to reduce harmful effect of boundary lubrication on machine life. In many cases it means departing from conventional lubricants and bearing materials.

A. J. Monaco

Managing Editor

LATEST LUBES and EQUIPMENT: For more info, circle key numbers on the Reader Service card provided on p 227

76 **Gas-valve lube** was developed to meet requirements of gas associations. It's a high-temperature nonmelting grease fortified with highly purified molybdenum-disulfide powder. Use it on plug cocks made of metal, plastics or glass where you need reliable lube in presence of gases or liquids. An added bonus: it's said to eliminate gumming formations.—The Alpha-Molykote Corporation

77 **Silicone grease** works as a rust inhibitor and lube for mated, threaded or nonthreaded ferrous components or fabricated rubber

For more facts circle 894 on Reader Service card, p 227

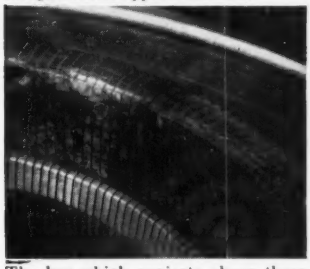
We look inside your commutator at National

...The Specialists in electric coils/repair service

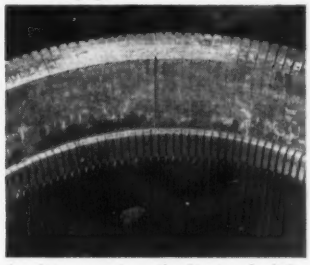
AND HERE'S WHAT WE OFTEN FIND!

Enlarged view of a dielectric puncture of a mica vee ring at the lower end of the copper bar. This is an example of interior commutator faults which may be present though exterior appears excellent.

Shifted or squirted mica at the apex of the 3° and 30° cone surfaces of a mica vee ring. The black lines on the 3°-surface were made by bar-to-bar voltage breakdown creepage.



The bar which projects above those adjacent has been locally overheated under a brush and softened.



A mica segment on the front end of the commutator has started to work out radially and will eventually result in a bar-to-bar short circuit.

When you send D-C machines to National for rewinding or rebuilding, the commutator gets a close inspection and test. But we've found from experience that a commutator that looks excellent on the surface may be in deep trouble inside... with mica cooked, varnish burned, loose copper, or imminent short circuits.

So when we are suspicious of the commutator we remove and open it for a close interior inspection. It's another added assurance that machines rebuilt by National will give you long, dependable service.

For more information, call National's Columbus plant... HUdson 8-1151. Or call the nearest National field engineer.

National Electric Coil

DIVISION OF McGRAW-EDISON COMPANY

COLUMBUS 16, OHIO

McGRAW EDISON

ELECTRICAL ENGINEERS • MANUFACTURERS OF ELECTRICAL COILS, INSULATION, LIFTING MAGNETS • REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES

For more facts circle 895 on Reader Service card, p 227

I wish we had more personnel and time to prepare this study for a new power plant and site.

Your regular staff is overloaded now. Call in the specialists and let them carry the peak load. How about Pioneer?

Give your non-routine operations to Pioneer

Design and Consulting Engineering Services. Pioneer has specialized in designing power plants for 57 years. It offers design service for fossil fuel, hydro and atomic plants. It will also assist in forecasting load growth, in site selection, in purchasing and expediting of equipment and in supervising construction. Pioneer's other services include substation, transmission and distribution studies and design.

Services in Regulatory Matters. Pioneer offers its services in all phases of Federal, State and Local regulation including the rate base, depreciation analysis, cost of service studies, market analysis, certificate proceedings and rate of return.

Corporate Services. Pioneer's services in corporate matters include business and management engineering advice, financial, accounting and tax counsel and insurance and pension plans and programming. It maintains a complete stock transfer, ledger and dividend disbursement service.

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On your letterhead, write for 40-page booklet, "Pioneering New Horizons in Power". Describes Pioneer's engineering services, and corporate services, from financing to operation.

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231 SOUTH LA SALLE STREET, CHICAGO 4, ILLINOIS.

Lubrication

parts. Known as SS-4007, it maintains its consistency from −75 to +300 F, sees service as a high- and low-temperature thread lube, corrosion-preventive compound, O-ring lube.—General Electric Company, Silicone Products Dept

78 **Premium lube** can be applied to 90% of ball- and roller-bearing installations, is reported to give good results with plain or needle bearings and on rotating and sliding surfaces. High film-strength lithium-base lube has excellent water-repellent properties. It also claims powerful absorptive properties, and it's odorless, smooth, nonfibrous, homogeneous. Six densities range from medium to very light. Operating temperature is 0 to 275 F.—Keystone Lubricating Company

79 **Increased wear life** of parts moving in oil or grease is predicted if you use new solid-film lube. No. 4856 contains small particles of lead, tin and graphite, known for good bearing properties. The material is semiporous so it absorbs oil, acts as a reservoir against metal-to-metal contact with high loads or during shutdown. It's said to be compatible with additives in most oils and greases. First developed for use on titanium under heavy loads, lube is now ready to protect your spherical bearings, clutch assemblies, leather oil seals, sleeve bearings, hydraulic - actuator parts.—Electrofilm, Inc

80 **Safeguard** forced-feed lube systems with this handy lubrication-line alarm. Install it simply by cutting line at each terminal point and connecting fittings. Hook it up electrically and it's ready to ring a bell, whistle, work a control-board light or start a relay to shut off motor in case of any stoppage. Standard unit works with any viscosity oil or synthetic lube at pressures to 10,000 psi. The low-cost alarm also comes in explosionproof models. — Houdaille Industries, Inc, Manzel Div

81 **Heavy-duty gear lube** is made of high-quality paraffin-base stock. It comes in SAE 90 and 140 grades, designed for gear cases

For more facts circle 896 on Reader Service card, p 227

Begins on page 248

operating at excessive frictional temperatures, gears loaded beyond maker's recommendations, cases of unsatisfactory wear life. With viscosity index of 100, 390-F flash point, 420-F fire point, type 223X is reported to have good load-carrying ability through entire range. You can pour it at zero F. — The Alpha-Molykote Corporation

82 **Get greater coverage** with no increase in solids content—this new molybdenum-disulfide additive for greases and heavy oils has predominantly finer particles in pre-wetted dispersion, gives 80% more hiding power than powder. Another advantage of 'dag' 208 is uniformity—easy handling, measuring and blending save time and labor.—Acheson Colloids Company

83 **All-synthetic** low-cost hydraulic fluid boasts the fire resistance and lube properties of a premium oil. Pydraul A-200 sells for a tankcar price of $2.85 a gallon. High compression resistance, excellent lubricity and stability, extended service life are reported features. —Monsanto Chemical Company

84 **Automatic grease cup** provides self-feeding lube with visible control for plain or rolling-contact bearings. A 4-oz reservoir is viewed through clear, unbreakable plastic cylinder. Spring and weighted plunger feed grease to bearing with predetermined pressure, according to maker.—Lubriquipment Engineers, Inc

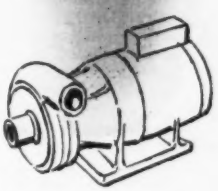
85 **Fire-resistant** hydraulic fluids see service in heavy-duty installations involving radial-piston pumps and high pressures. Pyrogard synthetic fluids are made in two types, four viscosities to meet requirements for h-p circuits and installations with high fluid-circulating temperatures. — Socony Mobil Oil Company, Inc

86 **Automatic bearing lubricator** holds a reservoir of lube, injects grease only as needed to prevent bearing burnout, over or under lube. Pressure cup shows at a glance when refill is needed—you can always see how much grease you have left. Units are 2¼-in. long, 1⅛-in. dia. Install

Nobody knows this RING BUSINESS like an old "PRO"

As a pioneer manufacturer of mechanical packings, Allpax has had extensive experience in developing and fabricating packing materials for the most exacting requirements of industry. Allpax rings for valves and pumps have proved themselves consistent winners through performance and preference in the field. All types are supplied in either molded, mandrel cut or endless form with butt or mitre joints.

✔ ***For manufacturers —***
Allpax Rings cut costs and do a better job because they are precision-made in a complete range of sizes and a wide variety of materials. Right types available for each pump or valve requirement for whatever material handled.



✔ ***For replacement —***
Accurate dimensions and proper types make replacement easier – insure a tight seal without danger of scoring or unnecessary wear on shafts or valve stems.

Use Allpax rings for:

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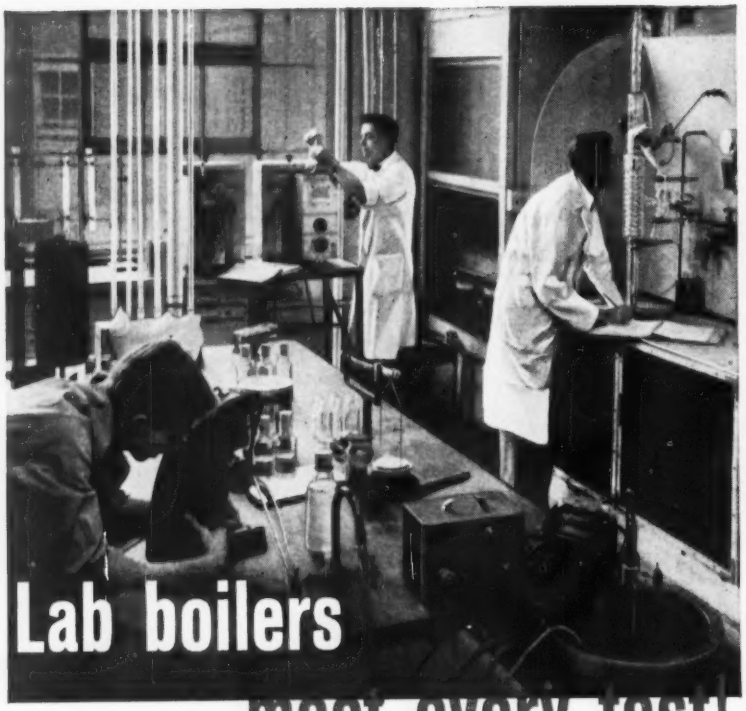
For more facts circle 897 on Reader Service card, p 227



Lab boilers meet every test!

Two Cleaver-Brooks 150-hp boilers satisfy all demands for steam at Shell Chemical Corporation's Union, New Jersey Technical Service Laboratories

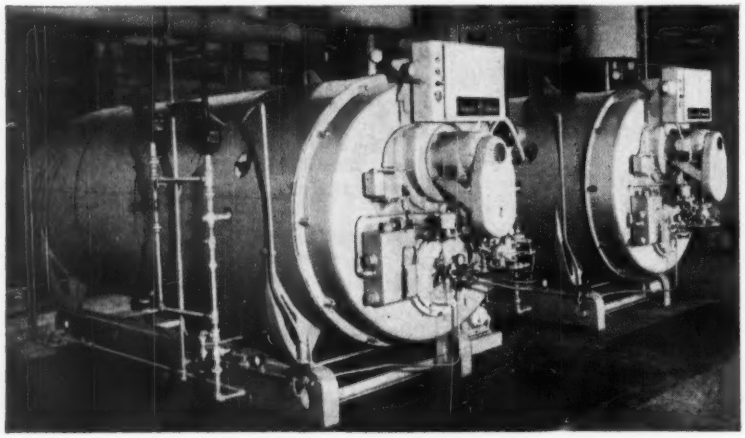
"We find Cleaver-Brooks boilers meet every test we have given them for top operating performance," reports George Baranchulk, utilities and service engineer at Shell's research building. Mr. Baranchulk goes on to say, "There is extreme versatility to our load as our requirements for heating and experimentation may run as low as 10 hp in the summer to over 140 hp in the winter. Checks we have made of CO_2 and stack temperatures indicate we are getting excellent operating efficiency — even when we vary the load over widely separated peak and low demands. These boilers have definitely lived up to every claim you have made for them."

Put Cleaver-Brooks packaged boilers to the test! They are available in sizes from 15 to 600 hp . . . for oil, for gas or for oil/gas combination firing. Contact your representative or write Cleaver-Brooks Company, Dept. L, 301 E. Keefe Ave., Milwaukee 12, Wisconsin.

Cleaver Brooks®

ORIGINATORS AND LARGEST PRODUCER OF PACKAGED BOILERS

TESTING — Fully modulated Cleaver-Brooks boilers burning No. 6 oil supply steam for heating presses, constant temperature rooms, laboratory uses, laminating plastics and air conditioning system. Sold and serviced by Miller & Chitty Company, Union, N.J.



them one per bearing by removing fitting and screwing cup into place; fill them with a standard grease gun. Lube units cost $18.25 a dozen.—Anchor Chemical Co

87 **Ball-bearing grease tool** lubricates sealed bearings. You slip bearing into a hollow shaft set on a circular base, then use a hand grease gun to force grease through shaft to a tube in base and out, under pressure, into the bearing. Two models handle bearings with OD's from ¾ to 2 in.—P-G Corporation

88 **Lubricating brush** and cleaning brush team up to keep your chains in good condition. Stainless-steel shank brush cleans chain automatically on the job. It precedes the lube brush and wipes off any foreign matter picked up in dirty surroundings, as well as abrasive contaminated lube. Lube brush features a mechanical bond securely attaching bristles—bristles available are made of horsehair for normal applications, nylon for high-speed chains, stainless steel for h-t lube. Sizes are ⅝, 1 and 1½-in. dia, ⅜x2¼ in.—Oil-Rite Corporation

89 **"Wear-in" compound** made of molybdenum disulfide shortens wear-in period without use of abrasives. It also reduces galling, seizing and excessive wear, according to manufacturer. You don't need to burnish it into surface for maximum effect.—The Alpha-Molykote Corporation

90 **Oil reclaimer** purifies diesel-engine lube oil at a flow rate of 100 gph. Explosionproof electrical equipment, all-steel construction is used. Other features are inlet fuller's-earth filter, automatic-draining distillate-collection tank. —The Hilliard Corporation

91 **Filter-oiler-regulator** filters air, removes moisture, supplies oil mist and regulates oil pressure to desired value, according to maker.—Oil-Rite Corporation

92 **Fire-resistant fluid** can be used in any hydraulic system—viscosity index is 130. You can use this fluid at pressures up to 2000 psi, operating temperatures to 150 F. —Sun Oil Company

For more facts circle 898 on Reader Service card, p 227

Begins on page 248

FREE LUBRICATION and LUBE EQUIPMENT DESIGN AIDS: For your copies circle key numbers on convenient Reader Service card on page 227

427 **Oil selection** and maintenance for roller and silent chain drives is covered in 4-p bulletin 54. Includes charts. Sun Oil Company

428 **Lubrication selector chart** for extreme-pressure jobs is included in informative 4-p bulletin 121. The Alpha-Molykote Corporation

429 **Wear-in compound** for breaking in new or rebuilt machinery is topic of 2-p bulletin 120. The Alpha-Molykote Corporation

430 **Effect of lubes** on wear-in damage to new machinery is discussed in 8-p newsletter 5. The Alpha-Molykote Corporation

431 **Industrial lubrication line**—specialty lubes, greases, heat-transfer and refrigeration oils—is covered in 16-p folder. Sun Oil Company

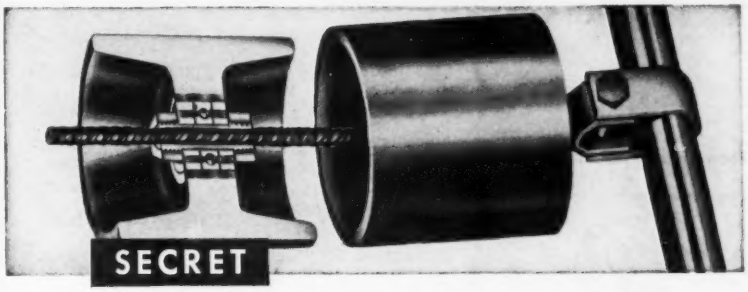
432 **Automatic desludgers** for fuel and lube oils are discussed in 8-p bulletin 2177. These centrifuges can purify up to 1200 gph of motor testing-stand oil. Centrico, Inc

433 **Centrifugal separators** for purifying lube and fuel oils are topic of informative 8-p bulletin 2141. Centrico, Inc

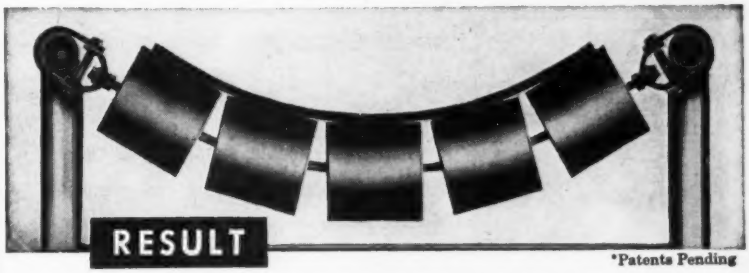
"We dedicate this report . . . to foreman Thomas . . . whose stupid orders . . . . made this all possible."

NEW (EXCLUSIVE WITH McNALLY PITTSBURG) CONVEYOR DESIGN

. . . slashes maintenance cost! . . . extends belt life!



. . . of the amazingly improved efficiency of this modern belt conveyor is shown here. This new McNally Pittsburg Cradle Idler* consists of 5″ rubber rollers assembled on precision ground ball bearings, prelubricated and lifetime sealed. Being a *true catenary* suspension with rollers mounted on flexible, *non-rotating* stainless steel wire rope, this design eliminates "loping" and dangerous harmonics.



*Patents Pending

. . . is greater capacity and faster belt operation with minimum spillage. Since the belt lies in true arc with no creases or bends to cause wear, *belt life is substantially increased.* Because this McNally Pittsburg conveyor design is so simple, costs are lower, and erection time is reduced.

WRITE TODAY | for details on the new conveyor which costs less to install . . . *saves money every day it is in use.*

McNALLY · PITTSBURG

McNally Pittsburg Mfg. Corp.
Dept. PO, Pittsburg, Kansas

☐ Please send information on the new McNally Pittsburg belt conveyor.

☐ Have Sales Engineer call for further consultation.

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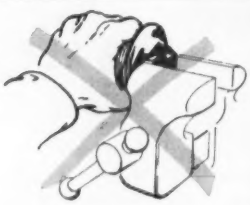

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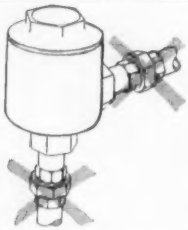

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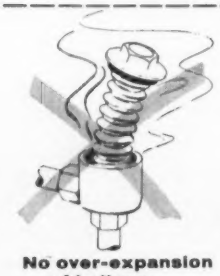

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Now — costly, time-consuming steam trap repairs are outmoded. For with this new B-J Cage Unit replacement, you simply drop a complete new interior into the trap and it's new again. And if steam trap maintenance is a bugaboo with you — it's the best and biggest drop you can make.

Also — Barnes & Jones Cage Unit interiors are available to renew other makes of industrial traps.

If you're interested in saving steam, cutting repair and maintenance time and improving trapping efficiency, write today for "The Steam Trap Primer". You'll see the 'hows' and 'whys' of steam trap performances. And perhaps you'll see how B-J high pressure traps and cage units can end your steam trap problems.

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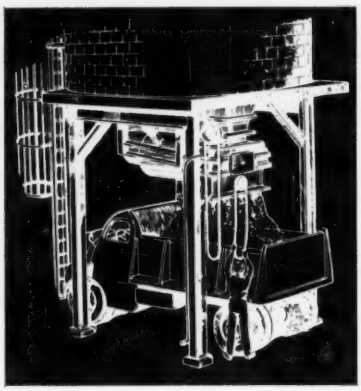
BJ

Barnes & Jones, Inc.
36 Crafts Street
Boston 60, Massachusetts

MATERIALS HANDLING and STORAGE



Automation highlights recent happenings in fuel and ash handling as this field swings more and more toward completely automatic control. And this holds for complete handling systems as well as individual items of equipment. Newest wrinkle is a gravimetric weighing device that permits solid-fuel flow-rate control by automatic combustion controls.

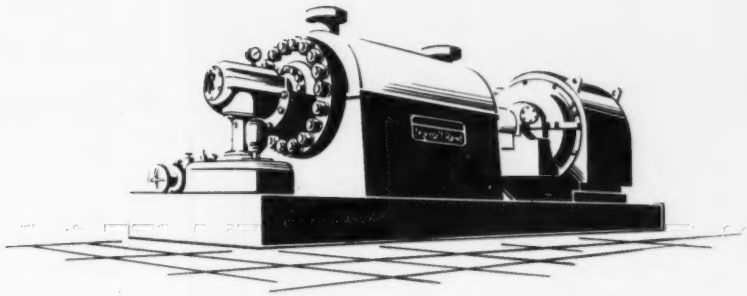
Less exotic, perhaps, but still vital to good plant operation are developments in conveyor accessory equipment. Attention given to pulley lagging, idlers, cleaning brushes and protective equipment resulted in improvements in these areas this past year. Reduction of lubrication worries is aim of pre-greased conveyor idlers said to need no further lube attention once on the job.

D. W. Folkmann

Assistant Editor

NEW EQUIPMENT DEVELOPMENTS: Circle key numbers on Reader Service card, p 227 to get complete details

93 **Higher accuracy,** resulting in closer control of air-fuel ratio, equal division of fuel flow among several firing units of a single boiler, direct regulation of rate of coal feed by combustion-control-system impulses is promised by this newly developed gravimetric feeder. Unit feeds coal continuously *by weight* instead of by volume, combining usual functions of a coal scale and feeder. Exactly 100 lb of coal discharges for each turn of the head shaft, so head-shaft speed is equivalent to rate of coal feed, can be expressed as lb of coal per minute



superlatives

that demonstrate confidence in a high-pressure boiler-feed pump and its builder

LARGEST CAPACITY ..... *7200 gpm.* Two record-breaking 7200-gpm pumps with discharge pressure of 4550 psig, for two 450,000-kw generating units.

HIGHEST PRESSURE ..... *6500 psig.* Two half-capacity units, each consisting of three pumps in series, with discharge pressure of 6500 psig, for a 325,000-kw station.

HIGHEST HORSEPOWER ..... *23,000 hp.* Two large capacity, high-head pumps, each driven by a 23,000-hp steam turbine, largest ever built for boiler-feed service.

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GREATEST ACCEPTANCE ..... *Ingersoll-Rand* has built far more high-pressure boiler-feed pumps than any other manufacturer — including many *high-speed* units for generating stations. These superlatives demonstrate industry's confidence in I-R Class CHTA pumps, and in Ingersoll-Rand's ability to design and build to any requirements — even those that go beyond previous industry experience. For maximum dependability and long-range economy, specify boiler-feed pumps by Ingersoll-Rand.

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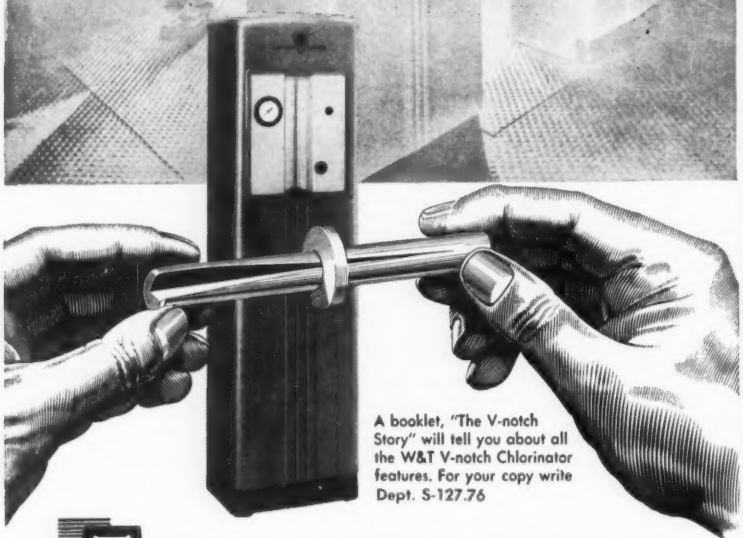

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or per hour. Unit comes in a cylindrical housing for pulverized-coal units, a dust-tight rectangular housing designed for internal operating pressure of two psi for cyclone units.—S-E-Co

94 **Belt-fed coal scale** automatically weighs, continuously records 15 tons per hr of coal, other bulk materials. Record is said to be accurate to 0.25%. You can instantaneously set scale to bypass feed chute or to resume automatic operation. Unit also comes in portable models for making periodic boiler-efficiency checks. —Beaumont Birch Company

95 **Low-cost and efficient,** rugged new conveyor brush sweeps belt clean of coal and other material carryback without injuring belt surface. Replaceable strip brushes said to be 80 to 100% efficient are made of Korfil P, a synthetic material that won't absorb moisture, soften or become brittle in high- or low-temperature service. Brushes are set in extruded-aluminum mounting. Hard-rubber end bushings support mounting on shaft—rubber won't mark shaft and doesn't corrode.—The Osborn Manufacturing Company.

96 **"Do-it-yourself"** dust-control formula is diluted with water 1 to 1000, then sprayed on dust-producing aggregate. Use it to control dust in car or truck dumping, crushing, screening or conveying, wherever some moisture can be tolerated.—Circle Chemical Co

97 **Conveyor pulley lagging** is cold-bonded to steel surface of pulley without removing it from conveyor, saving expense and downtime. Lagging is a wear-, acid-, heat- and water-resistant neoprene sheet. It bonds with adhesive strength of 3700 psi and no special tools are needed for application. Newly lagged pulley goes right back to work.—General Splice Corp

98 **Tramp-iron separator** is a permanent ceramic magnet made of barium ferrite. Ceramic material is compacted under great pressure, then permanently magnetized. Units are used in magnetic pulleys at the head of a belt-conveyor system or in grate mag-

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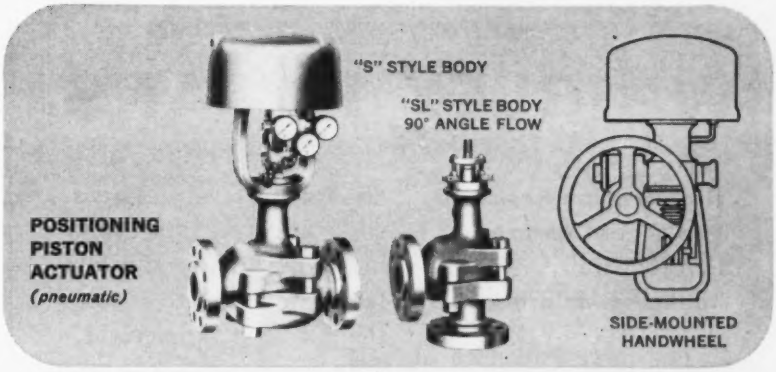

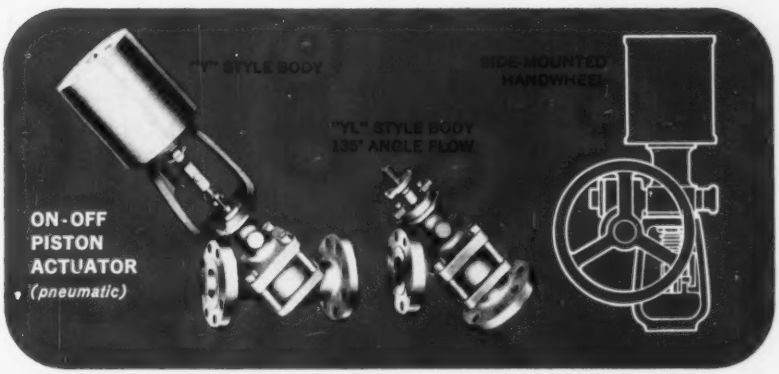

Specifications

Sizes: ½" – 8"

Connections: 150 to 1,500 lb. ASA flanged. Screwed or welding ends through 2". Separable or integral flanges.

Bodies: Carbon steel, 316 SST, nodular iron, bronze or any castable alloy.

Trim: Materials and characteristics as specified.

Face-to-Face: I.S.A. Standard – all sizes on "S" and "SL" bodies – through 4" size on "Y" and "YL" bodies. Non-standard face-to-face also available.

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For more facts circle 903 on Reader Service card, p 227

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The largest furnace in the country producing merchant pig iron was recently placed in service as part of an expansion program by a major Southern mill. The new furnace has a rated capacity of 1000 tons per day and is one of the most modern in the country with respect to mechanization and automatic controls.

Because of their unique design and high erosive resistance, WHIRLEX heavy duty induced draft fans were chosen to handle the hot blast furnace gas. The three units shown here carry approximately 150,000 cubic feet of gas per minute. Preliminary fan examinations show wear to be less than a third that of ordinary fans designed for this purpose.

A Whirlex fan installation may solve your problem. Write or wire us.

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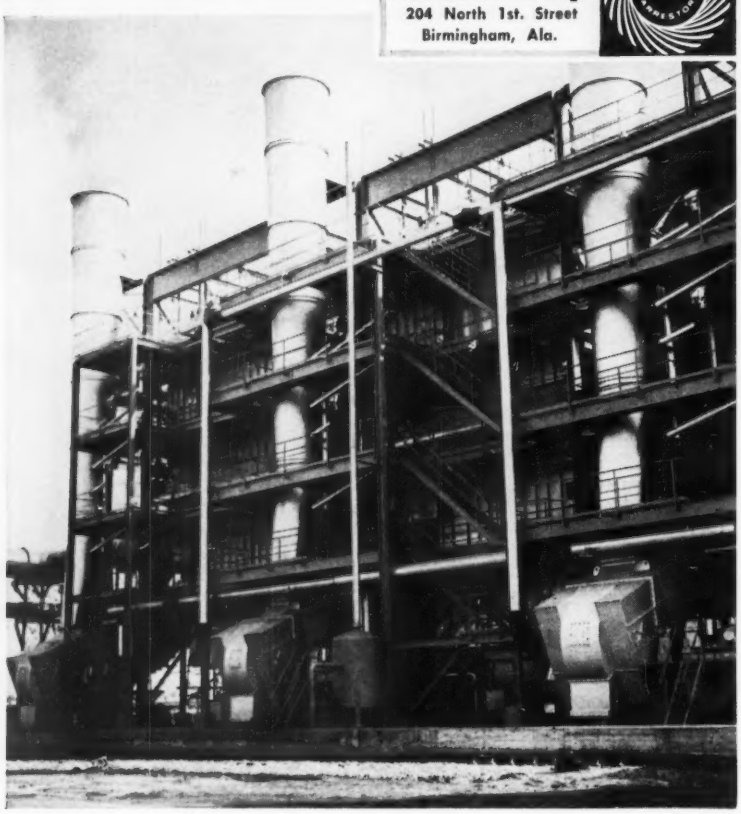
WHIRLEX



Materials handling

Continued from page 254

nets in a hopper, chute or duct.—Stearns Magnetic Products

99 **Ceramic magnetic pulleys** remove long, medium or heavy tramp iron from fast-moving flows of material. Units come in five standard diameters from 12 to 24 in., belt widths starting at 12 in. They work best at 20 to 120 F ambient.—Eriez Manufacturing Company

100 **Belt-conveyor idlers** are filled with grease at factory; you install them without worrying about further lube. Five series in widths from 14 to 84 in. add up to 630 types and sizes. Flat, 20-deg and 45-deg troughed units, positive-action and actuating-disk training idlers are some types available.—Link-Belt Company

101 **Heavy-duty air vibrator** helps unload railroad hopper cars faster. Only moving part is the piston, featuring long stroke for maximum amplitude and thrust. Stainless-steel mounting head promises long life; there are no body assembly bolts to wear out or fatigue. The 3-in.-piston model is 14¼-in. long, weighs 68 lb, uses 18-cfm air at 40 to 60 psi; 4-in.-piston unit is 17½-in. long, weighs 115 lb, uses 29-cfm air at 40 to 60 psi.—National Air Vibrator Company

102 **Bin-level indicator,** an automatic unit, is used where corrosion or chemicals are present. Sensitive response mechanism isn't fazed by light or heavy materials. Unit comes in standard or explosionproof models.—The Bin-Dicator Company

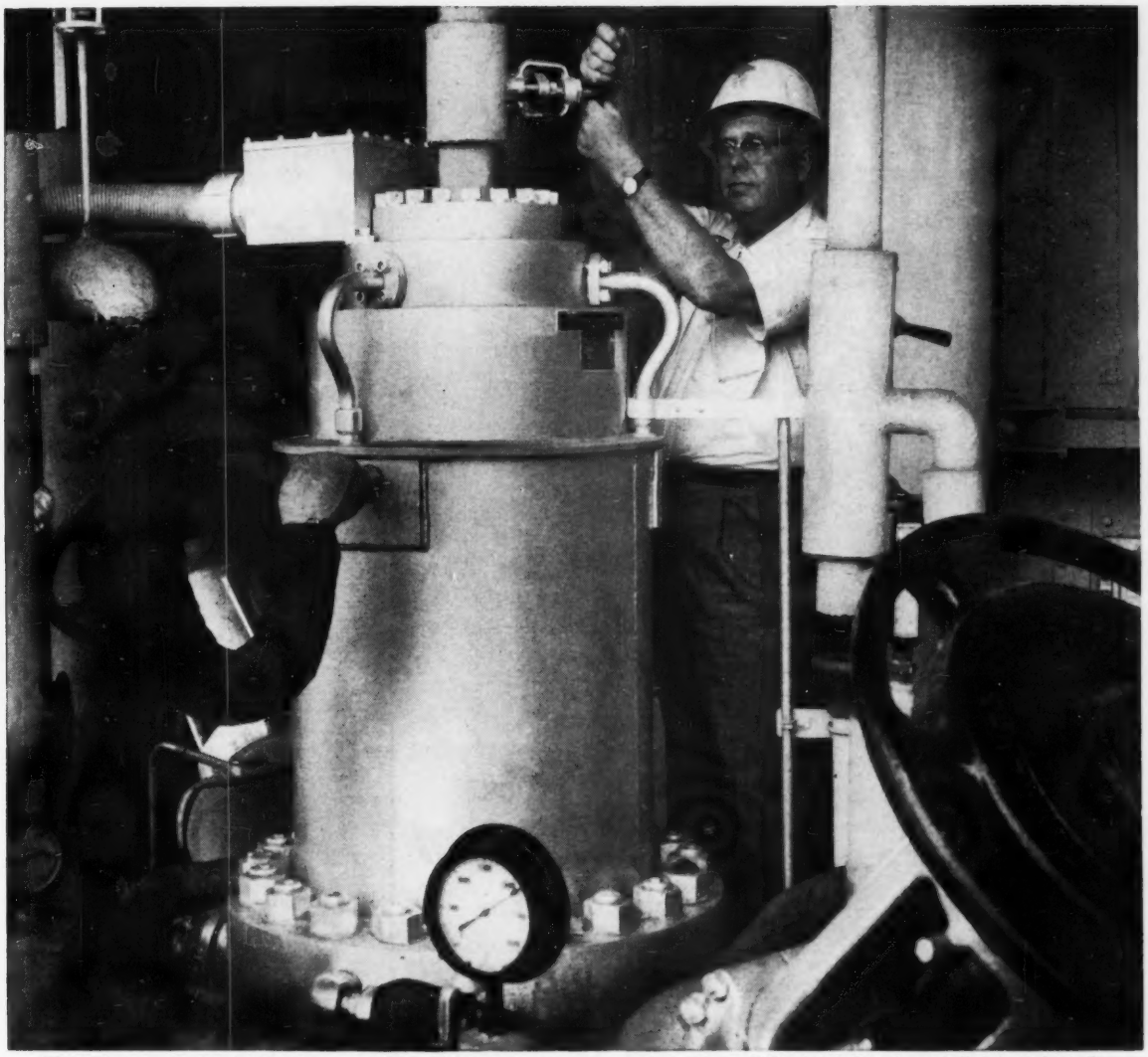
MATERIALS-HANDLING DESIGN AIDS: For free copies, circle key numbers on Reader Service card. See page 227

434 **Cradle idler** and belt conveyor is described in 8-p bulletin 458. Includes photos, dimensional drawings and capacity tables. McNally Pittsburg Mfg Corp

435 **Car pullers** are described in 8-p bulletin 753. Photos illustrate sheaves, hooks, rollers and pullers. Stephens-Adamson Mfg Co

436 **Conveyor-belt carriers** are topic of 20-p bulletin 355. On-the-job photos, diagrams are included. Stephens-Adamson Mfg Co

437 **Conveyor-elevators** are discussed in 62-p bulletin 358. Diagrams,



VEPCO's Yorktown No. 2 installation shows one of three 7580-gpm canned motor-pumps operating at 2120 psi, 620° F on the controlled circulation boiler.

Westinghouse canned motor-pumps installed at Yorktown and Chesterfield power stations

Operating experience with a similar installation of Westinghouse canned motor-pumps on a controlled circulation boiler at Virginia Electric Power Company's Possum Point* station led to the selection of this pump for both the new Yorktown* and Chesterfield* plants.

Proved in many utility installations, Westinghouse canned motor-pumps have a record of reliable service during long-term, continuous operations. They improve station efficiency, are easy to operate and require almost no maintenance.

- Pump and motor casings completely enclose the pump shafting, eliminating troublesome conventional shaft seals and power-consuming seal-injection systems.
- Watertight Inconel cans keep rotor and stator windings dry and trouble-free.
- Field inspection reports prove the reliability and minimum wear characteristics of water-lubricated bearings.

For full information on how Westinghouse canned motor-pumps can save you money in a controlled circulation boiler installation, contact your Westinghouse sales engineer or write: Westinghouse Electric Corporation, Atomic Equipment Department, Cheswick, Pa.

*Architect-Engineer, Stone & Webster

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Materials handling

Continued from page 254

drawings, photos show conveyors and accessories for all applications. Stephens - Adamson Mfg Co

438 **Sectional type belt conveyors** are topic of 40-p booklet 2779. Includes installation, applications, engineering and selection data. Link-Belt Company

439 **New devices** for remotely handling radioactive, toxic or highly flammable materials are described in 20-p booklet. General Mills, Inc, Mechanical Div

440 **Belt-conveyor idlers** are described in 40-p handbook 2716. Detailed engineering selection data covers 14- to 84-in. units. Link-Belt Company

441 **Materials-handling** improvement through use of systematized pneumatic equipment is topic of 12-p ASME reprint. Fuller Co

442 **Materials - handling equipment**—vibrators, car shakers, flow-control valves—is included in 68-p catalog 591. Syntron Company

443 **Belt conveyors** are topic of 88-p catalog ID-591. Photos, diagrams and tables describe heavy-duty and standard roller-bearing and precision ball-bearing idlers. Continental Gin Company, Industrial Div, Materials Handling Dept

444 **Multipurpose dumpers** are listed in 8-p catalog. Photos show applications, adaptations. Specs are included. Essex Conveyors, Inc

445 **Block and sheave** specifications are given in 10-p catalog 1. Includes capacities, wire-rope sizing info. Sauerman Bros, Inc

446 **Conveyor belt** is topic of 12-p brochure M302. Drawings detail compensation. Raybestos - Manhattan, Inc, Rubber Div

447 **Bin device** to eliminate rat-holing, arching and funneling of coal is covered in 4-p bulletin BD958. Unit delivers up to 7000 lb per min. Fairmont Machinery Company

448 **Coal-handling equipment** is discussed in relation to overall plant design in 16-p booklet A-2029. Link-Belt Company

449 **Crusher** with ring type double rotor is described in 4-p bulletin 858. Stephens-Adamson Mfg Co

450 **Vibrating screens** are covered in comprehensive 48-p booklet 2777. Describes screen cloths, accessories. Tables list materials and selection data. Link-Belt Co

451 **Coal preparation** and handling equipment is described in 128-p manual 559. Includes photos, di-

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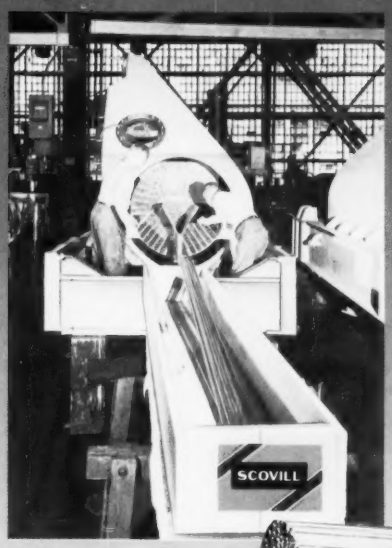

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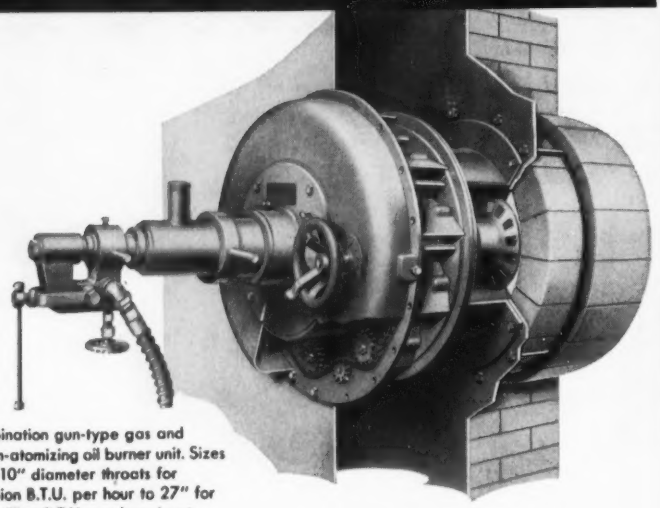
ENCO

TYPE E OIL BURNER UNIT



Combination gun-type gas and steam-atomizing oil burner unit. Sizes from 10" diameter throats for 7 million B.T.U. per hour to 27" for 100 million B.T.U. per hour input.

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Air register vanes are easily adjusted by a single hand wheel for either clockwise or counter-clockwise air rotation. The action is without stiffness or sticking. Vane shafts are stainless steel — heat-resistant, corrosion-proof — turn smoothly in carbon graphite bearings at all operating temperatures.

2. Positive Vane Control — no lost motion

Chain-and-sprocket air-vane control, with take-up adjustments, assures easy and precise setting at all times. There are no links to wear and wobble with a flopping action of the vanes when they pass dead center.

3. Adaptable to oil or gas — or both

Changeover from oil to gas or a combination of both can be done easily — with comparatively low cost standardized parts—to get the full advantage of variations in fuel prices.

4. For wide range or standard range burners

Registers accommodate standard range or wide range oil burners — mechanical or steam atomizing — and gun type or ring type gas burners—the one best type or combination for your individual needs.

5. Adaptable to all housing designs

Extra deep burner housing can be used to suit practically any fan and any duct arrangement — with lowest installation cost — and provide proper air distribution for efficient combustion.

Bulletin G59 gladly sent on request

EC513

THE ENGINEER COMPANY

75 WEST STREET, NEW YORK 6, N. Y.

Materials handling

Continued from page 254

mensional drawings and capacities, plus essential engineering data, reference tables. McNally Pittsburg Mfg Corp

452 **Belt-conveyor scales,** control systems are covered in 8-p catalog 2M. Schematics show typical applications of the units. Trans-Weigh Company

453 **Dry-chemical feeders,** volumetric-extrusion type, are discussed in comprehensive 16-p bulletin 215. Infilco Inc

454 **Protective spray** for outdoor stockpiles is described in 4-p bulletin P58-1. Johnson - March Corp

455 **Ship-to-shore** coal handling at one ton per sec is described and illustrated in 4-p bulletin 1157. Stephens-Adamson Mfg Co

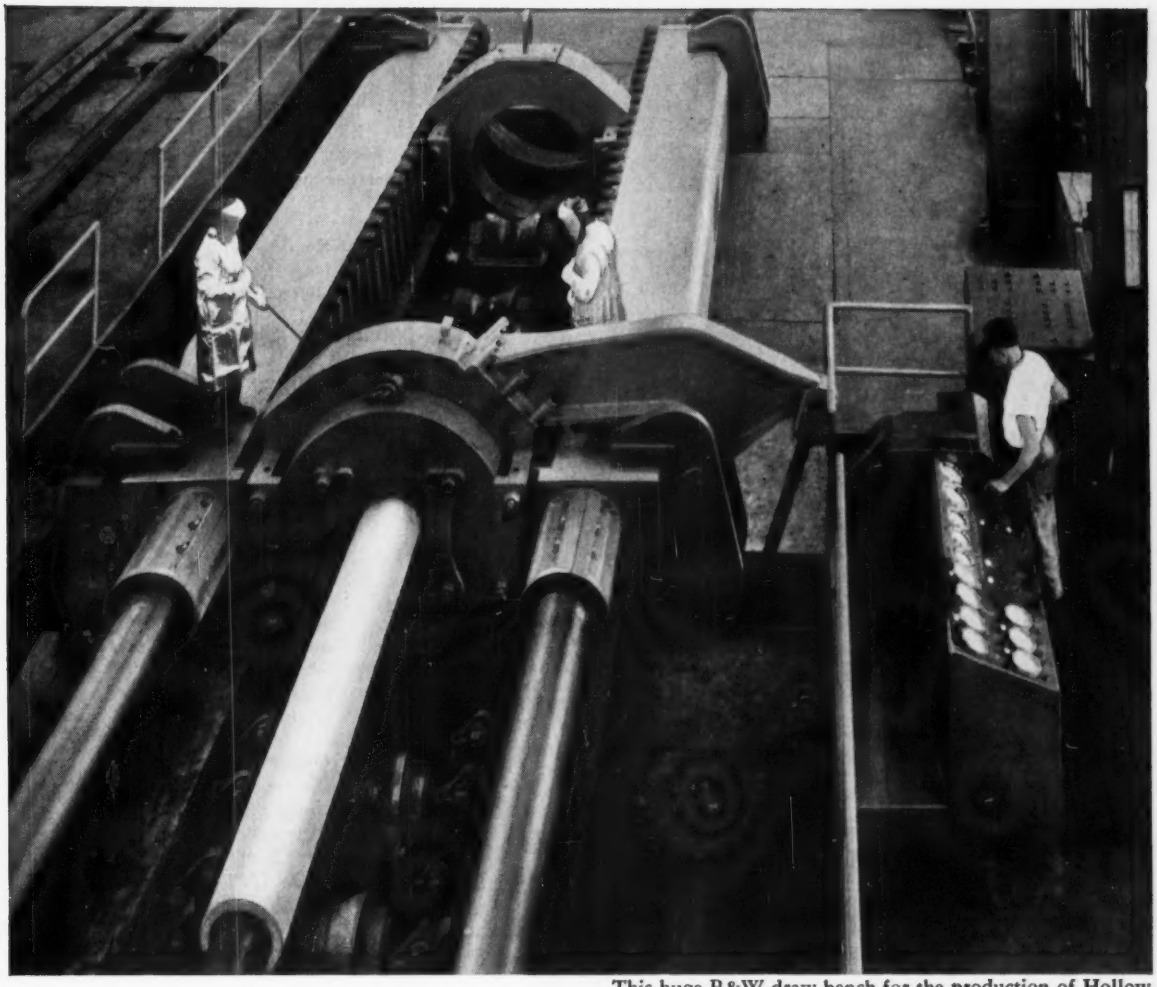
456 **Coal feeding** and weighing system is subject of 16-p catalog. Installation photos, diagrams give complete details. Bell Automation Corporation

457 **Coal breakers,** crushers are covered in 38-p bulletin 658. Includes drive data, dimensional drawings and capacities. McNally Pittsburg Mfg Corp

458 **Coal samplers,** primary and secondary units, are topic of 8-p bulletin 259. Photos, dimensional drawings illustrate samplers. McNally Pittsburg Mfg Corp

"I guess we'd better get a car shaker. We can't depend on earthquakes all the time."

For more facts circle 910 on Reader Service card, p 227



This huge B&W draw bench for the production of Hollow Forgings is capable of taking a 26,000 pound pierced ingot.

B&W Hollow Forgings —for piping economy in heavy-duty service

Petroleum and power engineers have found a solution of their piping problems at B&W. They save time and money by specifying high-quality B&W Hollow Forgings that have been produced under carefully controlled conditions from initial electric furnace melting through final inspection. B&W production techniques include uniform and thorough working of the ingot, which result in excellent forging properties.

Piping is being supplied in a wide range of fractional sizes and a selected range of standard pipe sizes in carbon, intermediate Croloy and stainless Croloy steels.

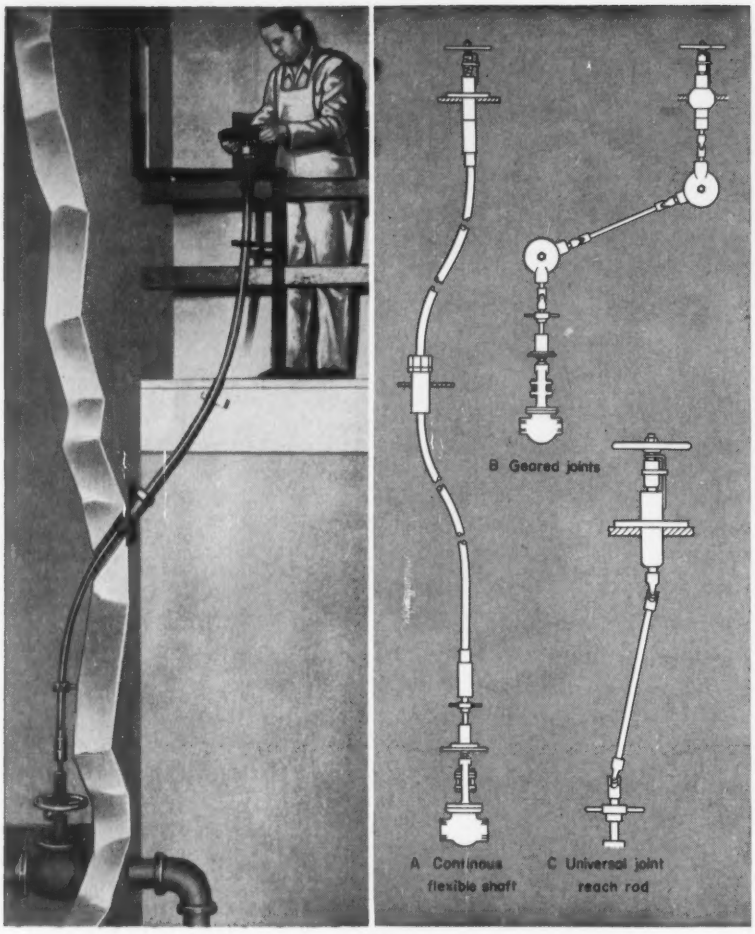
For additional information, write for Bulletin S-16. The Babcock & Wilcox Company, Boiler Division. Barberton, Ohio.

Ask for this BULLETIN: S-16

S-474-HF

B&W THE BABCOCK & WILCOX COMPANY

BOILER DIVISION



Typical station arrangements

Remote control for valves

In recent years increasing numbers of manual remote controls have been installed in industrial power plants and on nuclear reactors. These systems are popular because they eliminate a great deal of hazardous climbing and permit relatively inexpensive control of a number of widely scattered valves.

Stow Manufacturing Co. makes a complete line of these controls, including: flexible shafting, universal joints and geared joints. These controls also include standard remote stations, intermediate connections and valve couplings for both flexible shafting and reach rods.

Typical installations of this equipment are shown above. Sketch "A" shows a flexible shaft that can be used up to 100 ft. in length and is available in sizes up to 1⅝" diameter. Sketch "B" is an installation using geared joints that operate in any angle through 340°.

For complete design data on all sizes of standard flexible shafts, geared joints and terminals, write for Design Manual 5811.

STOW MANUFACTURING CO.
181 Shear Street, Binghamton, N. Y.

PRIME MOVERS

THIS YEAR'S NEW PRIME MOVERS: Circle key numbers on the handy Reader Service card provided on p 227 to get the complete product story

103 **Revving up** for high-reliability long-life duty is a 300-hp supercharged gas-turbine engine, the *704*. Unit tips the scales at 650 lb installed, ¼ the weight of a comparable diesel, with fuel economy rivaling diesels and superior to conventional gasoline engines, maker reports. Engine uses two stages of air compression and dual burners. You get maximum fuel economy through a range of 25 to 100% full power. Possible fuels for the 38x29x28-in. unit include unleaded gasoline, kerosene and light diesel fuel, with no warmup period needed. Auxiliary and standby power generation are some uses for the unit, now in final test stage.—Ford Motor Company

104 **Compact, reliable** V type 2-cycle gas engine will see service in power generation, as a driver for pumps or centrifugal compressors in pipeline booster stations. Model *TPV* has 17x19-in. bore and stroke, comes in 10-, 12- and 16-cylinder sizes rated at 4000, 4800 and 6400 bhp. Unit is reported to combine low fuel consumption with 2-cycle simplicity—2/5 of parts needed for comparable 4-cycle engine are eliminated.—Clark Bros Company

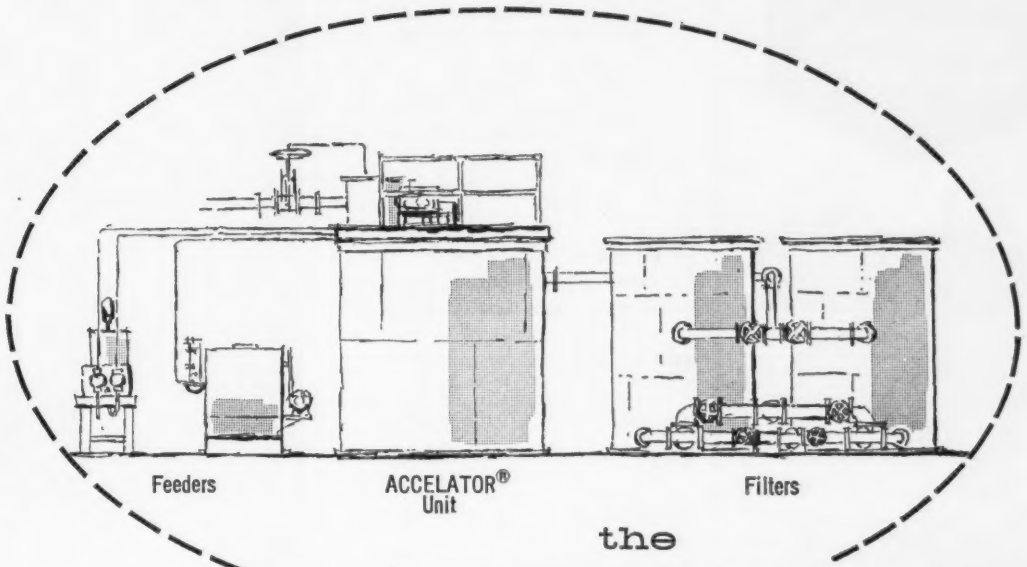
105 **Vertical steam turbines** in 100- to 1000-hp range are specially designed for pump drives and similar power-supply applications. Small mounting diameters take little installation space, to give you greater freedom of location. Turbines are capable of speeds to 8500 rpm, steam pressures to 1250 psig.—The Whiton Machine Company

106 **Gas-turbine engine** is bidding for duty as power source for generator sets, compressor and pump drives. Constant- and variable-speed models weigh 950 lb, produce 1250 hp. Simple-cycle fuel consumption is 0.60 lb per hr, thermal efficiency is 23%.—Solar Aircraft Company

107 **Building-block components** cut engineering and manufacturing time cycles on this single-valve

For more facts circle 912 on Reader Service card, p 227

A complete "package" water treating plant...



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ACCELAPAK®

plant

COMPLETE—from inlet to outlet—nothing else required.

ADAPTABLE—for clarification, softening, iron or color removal, and sterilization. Pressure or gravity filters, as required.

STANDARDIZED—pre-engineered in all sizes with standardized dimensions in capacities from 15 to 350 gpm.

SIMPLE—working parts, easily accessible for minimum required attention. Simple erecting and operating instructions.

DEPENDABLE—treatment results are easily obtained; uniformly and dependably maintained.

ECONOMICAL—costs of plants are low due to quantity purchasing and production; installation space is small; maximum utilization of treating chemicals is assured.

9401

Write today for full details on the "ACCELAPAK" plant in Bulletin 1870-A or request Bulletin 80 showing our complete line of water and waste treating equipment.

INFILCO

INFILCO Inc.

General Offices, Tucson, Arizona

Field offices throughout the United States and other countries.

For more facts circle 913 on Reader Service card, p 227

THE ONLY
Feedwater Heater
WITH THIS GUARANTEE

STICKLE OPEN COIL FEEDWATER HEATER

Only Stickle open coil tray-type feedwater heaters are backed by this important guarantee. And the guarantee has been unchallanged since 1912 when Stickle built the first unit of this type. Some early models are still in continuous operation after 46 years! Now custom built in deaerating and non-deaerating types, in a wide variety of styles, to meet each space and storage requirement. Capacity range from 3,000 to 300,000 pounds per hour. It pays to specify Stickle.

FREE BULLETIN!
For helpful data on feedwater heaters, and a look at the various Stickle models, write for 12-page Bulletin 117-A.

STICKLE STEAM SPECIALTIES CO.
2265 Valley Ave. • Indianapolis 18, Ind.

Prime movers

Begins on page 266

multistage mechanical-drive turbine, add up to price reductions for you. Unit will drive pumps and compressors, develops 500 to 4000 hp and 4000 to 10,000 rpm. It's available in condensing or noncondensing models with throttle pressure of 100 to 850 psig, temperatures to 900 F.—General Electric Company

LATEST PRIME MOVER DESIGN AIDS: To get your free copies, circle key numbers on Reader Service card, p 227

459 **Gas turbine,** 750 to 1000 kw, is described in 14-p bulletin 167. Gives design features, fuel types, applications. Clark Bros Co

460 **Horizontal steam turbines** are topic of bulletin 100-1-C. Units drive boiler-feed pumps, fans, condenser pumps and generators. Whiton Machine Company

461 **Diesel engines** producing 340 hp at 2000 rpm turbocharged, 230 hp at 2000 rpm naturally aspirated are detailed in 16-p bulletin BU540. Allis-Chalmers Manufacturing Company, Engine-Material Handling Div

462 **Turbine-generators** from 5000 to 100,000 kw for industrial and electric-utility applications are subject of 40-p well-illustrated booklet B-7373. Westinghouse Electric Corporation

463 **Combustion gas-turbine** uses in refining are described in 12-p bulletin 166. Clark Bros Co

464 **Differential-pressure** power unit utilizes gas flow to develop bonus power—6-p folder gives details. Troy Engine & Machine Co

465 **V type 4-cycle engines** are topic of 18-p bulletin 262. Explains design, construction features of the units. Nordberg Manufacturing Company

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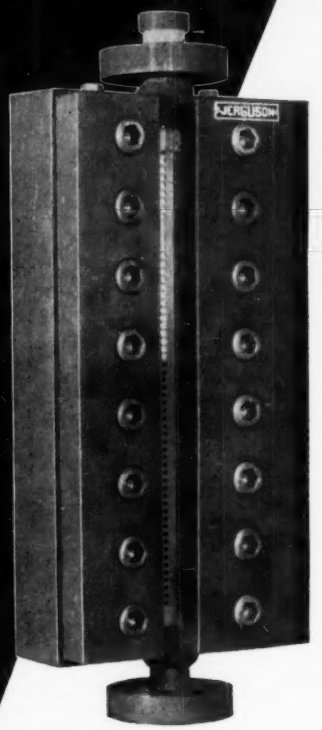
Computer at AIEE Atlanta meeting organized the engineers. Georgia Tech's Univac stored and processed all registration data for the meeting.

Over 17 million volunteers run United Community Campaigns, manage the funds and guide the year-round operation of the agencies. Give the United way—you'll be glad you did.

New Jerguson REFRAGAGE



BLACK & WHITE
water level on
HIGH PRESSURE BOILERS

The New Jerguson Refragage gives you a sharp black and white reading of water level on high pressure boilers . . . with contrast similar to reflex gage.

This rugged gage uses light refraction to give you a clear black water level topped by a brightly lighted line in the steam area. Level is easily seen at a distance and at angles to 20°; also ideal for TV or mirror transmission. It has full 12" visibility range and handles pressures to 3000 WSP.

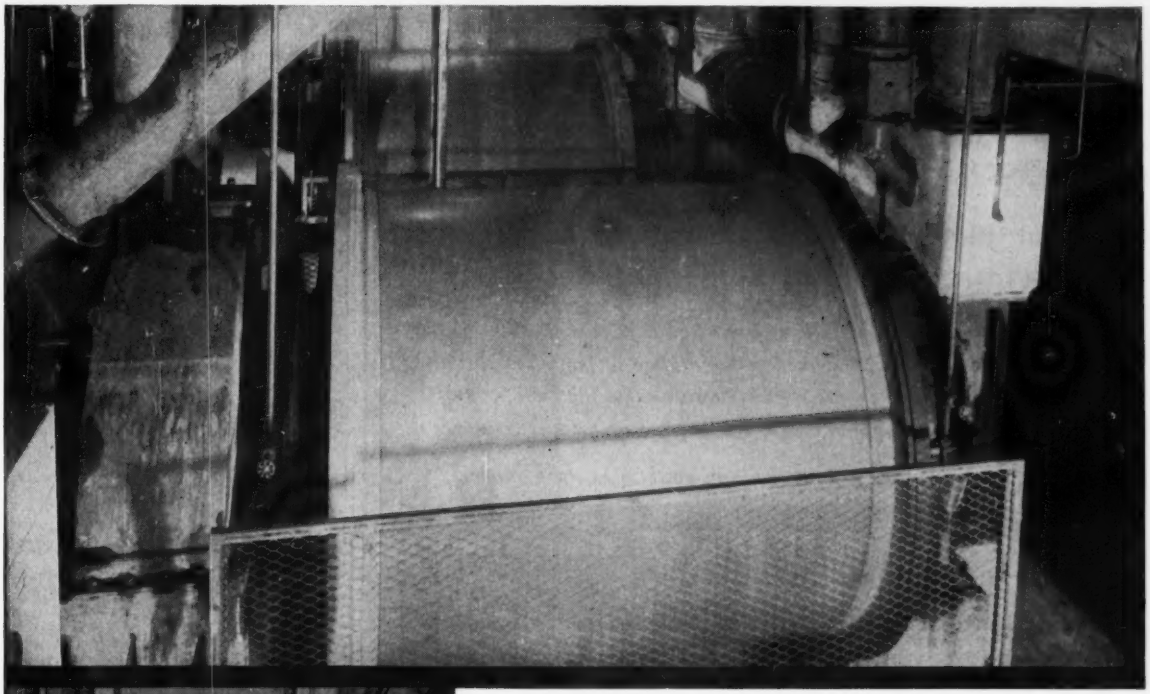
No glass to get broken and practically no maintenance necessary.

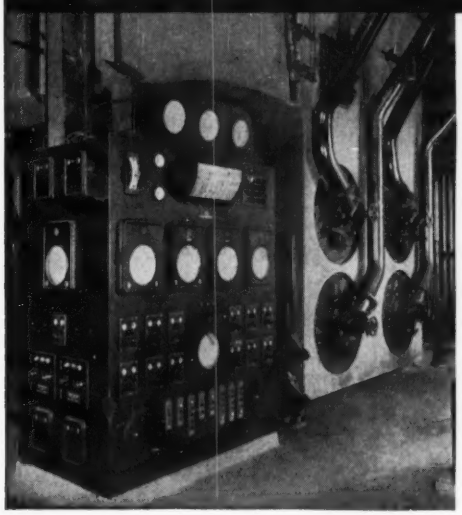
Ask for Refragage Catalog Sheet

JERGUSON
Gages and Valves for the Observation of Liquids and Levels
JERGUSON GAGE & VALVE COMPANY
100 Adams Street, Burlington, Mass.
Offices in Major Cities
In Canada: Peacock Bros. Ltd.

circle 914 on Reader Service card, p 227
circle 915 on Reader Service card, p 227

KENNEDY Pulverized Coal Firing System





. . . For Economy!

Shelby, Ohio—Municipal Light Department selects KENNEDY Pulverized Coal Firing System for 90,000 lb./hour steam plant generating 475 psig steam.

Shelby chose pulverized coal because of the availability of low cost coal, improved combustion efficiencies and lower stack losses, and because of its instant response to demand changes.

Shelby chose KENNEDY because no other pulverized coal firing system includes these desirable features:

- Fully air swept
- Coal pulverized to superfineness
- Coal completely carbureted, ready for combustion
- Big trunnions for air sweeping
- Balls added without shutting down
- Low operating and maintenance costs
- 85 to 90% through 200 mesh
- 20% moisture removed while pulverizing
- Pulverizes any coal—bituminous, anthracite or coke
- Tramp iron aids in pulverizing
- Reserves of fuel for fast response to demand

Consult KENNEDY before you specify your next firing system.

KENNEDY VAN SAUN
MANUFACTURING & ENGINEERING CORPORATION
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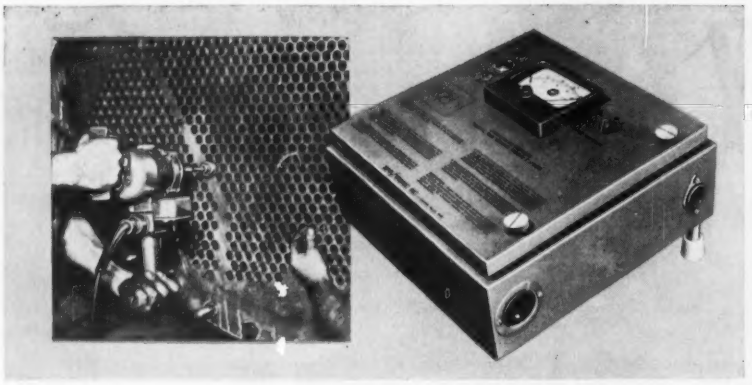


Your Motor + Wiedeke Torque Control = Increased Tube Rolling Production

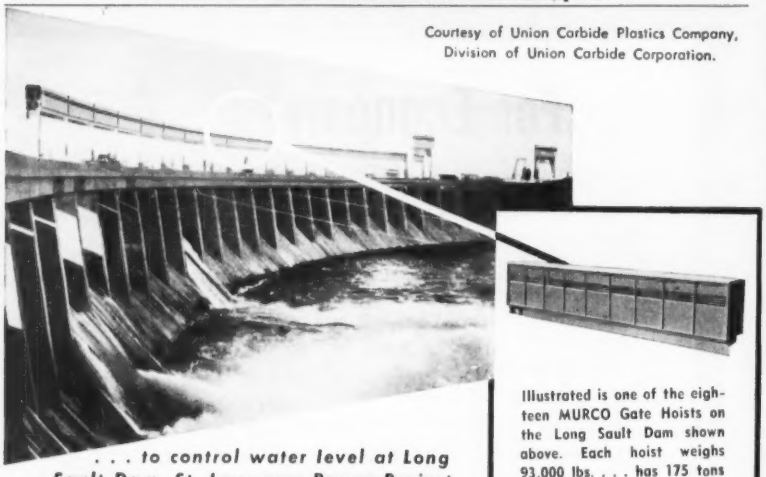
Save the cost of a new motor! New Torque Control Instrument for rolling ¼" through 4½" tubes in boilers, condensers and similar heat transfer vessels—operates with any Universal Reversible Electric Tube Rolling Tapper or Motor. Adjustable time cycle matches operator's dexterity.

WRITE TODAY FOR DETAILS AND BULLETIN AC-7A

The Gustav WIEDEKE Company
Dayton 1, Ohio

For more facts circle 917 on Reader Service card, p 227

Courtesy of Union Carbide Plastics Company, Division of Union Carbide Corporation.



. . . to control water level at Long Sault Dam, St. Lawrence Power Project

MURCO GATE HOISTS

For the second largest hydroelectric power plant in the United States at Massena, New York—as part of the St. Lawrence power project—Uhl, Hall & Rich, project engineers, selected MURCO Gate Hoists to control the water level at Long Sault Dam. MURCO Gate Hoists are designed from knowledge and experience . . . backed by over 75 years in design and manufacture . . . made for any size power dam . . . capacities from less than 1 ton to over 100 tons . . . from the smallest hand operated to the largest motor operated gate hoist, all made to specifications.

Illustrated is one of the eighteen MURCO Gate Hoists on the Long Sault Dam shown above. Each hoist weighs 93,000 lbs. . . . has 175 tons lifting capacity . . . will raise and lower the gates in the dam at a speed of 1 foot per minute. The overall length of each unit is 57 feet . . . 8½ feet wide and 12½ feet high. Write for complete information and Engineering Department recommendations.

Manufacturers Since 1883

MURCO

D. J. MURRAY MANUFACTURING CO.
WAUSAU, WISCONSIN

WELDING

NEW WELDING EQUIPMENT: For more info circle the key numbers on convenient Reader Service card, p 227

108 **Electron-beam welder** successfully joins reactive and high-melting-point metals for atomic reactors and missiles. Intense beam bombards materials to be welded in high-vacuum chamber. Vacuum eliminates danger of contamination by atmosphere, does double duty by removing contaminants from original work pieces. Beryllium, molybdenum, tantalum, zirconium and hafnium can be joined by this new process, according to maker.—Air Reduction Company, Inc

109 **Nickel-manganese electrode** is good for tough, wear-resistant hard surfacing and for strong, ductile welds. Use this low-hydrogen ac-dc electrode for joining and wear-surfacing austenitic manganese and carbon steels. Reported welded properties include: yield strength, 58,000 psi; tensile strength, 125,000 psi; elongation in two in., 50%.—All-State Welding Alloys Co, Inc

FREE WELDING DESIGN AIDS: To get your free copies, circle key numbers on Reader Service card provided on p 227

466 **Welding aluminum** is topic of 120-p comprehensive survey ADI 1258. Includes weldability data, definitions, technical discussions, equipment and power-supply descriptions. Air Reduction Sales Company

467 **Small-pipe welding** is topic of 12-p reprint ADR 118. Discusses techniques and system designing. Air Reduction Sales Company

468 **Welding equipment,** industrial regulators are discussed in 24-p brochure. Cross sections help evaluate oxy-acetylene design features. Modern Engineering Co

469 **Welding products** and practice are covered in 32-p brochure. Describes rods and electrodes that you can use for manual, automatic and semiautomatic welding. Arcos Corporation

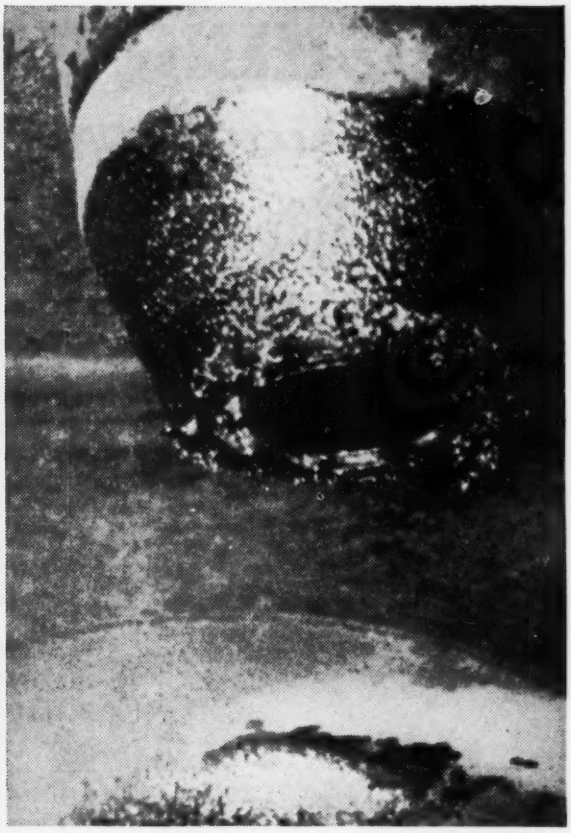
470 **Welding fittings** for noncritical plumbing, heating and cooling systems are covered in catalog H-1. Nibco, Inc, Steel Div

471 **Electrode** for dissimilar-alloy welding is covered in 6-p bulletin. Whitehead Metals, Inc

continued

For more facts circle 918 on Reader Service card, p 227

A typical example of nozzle deposits 2 days after manual cleaning BEFORE USING FOA-2.



The same nozzle is clean, burner operation improved, tank free of sludge 7 days AFTER ADDING FOA-2.

Why Du Pont Fuel Oil Additive-2 means greater economy, reduced downtime, less manual cleaning

Anti-sludge and anti-deposit action in tank, strainer, heat exchanger and nozzle minimizes maintenance operations

Du Pont Fuel Oil Additive No. 2 was developed to improve the performance of fuel oils by reducing the formation of residues and sludge. This nonmetallic copolymer additive burns completely, leaving no ash. It keeps insoluble material in a finely divided, well-dispersed, harmless state. FOA-2 has the additional advantage of minimizing incompatibility when two or more fuels are mixed.

For users of heavy fuel these properties mean trouble-free operation of handling and burning equipment. Results speak for themselves: the heating plant of a large Midwest industrial plant was using residual fuel containing 40% BS&W, with a high solids content. To prevent clogged nozzles and flame-out, storage tanks had to be cleaned at frequent intervals. To alleviate the problem, Du Pont FOA-2 was added to the incoming oil supply. After the additive was used for three weeks no sludge could be detected in the tanks.

The dispersing, stabilizing and solubilizing qualities of FOA-2 caused these improvements. Perhaps it suggests a way to improve your heavy fuel performance. For more information about the applications, properties, performance, methods of handling and adding FOA-2, just clip the coupon below.

DYES AND CHEMICALS

DU PONT

REG. U. S. PAT. OFF.

Better Things for Better Living . . . *through Chemistry*

P-10

E. I. du Pont de Nemours & Co. (Inc.)
Dyes & Chemicals Dept., Wilmington 98, Delaware

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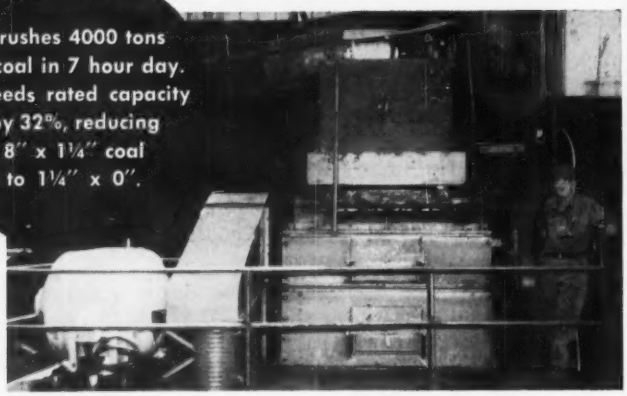
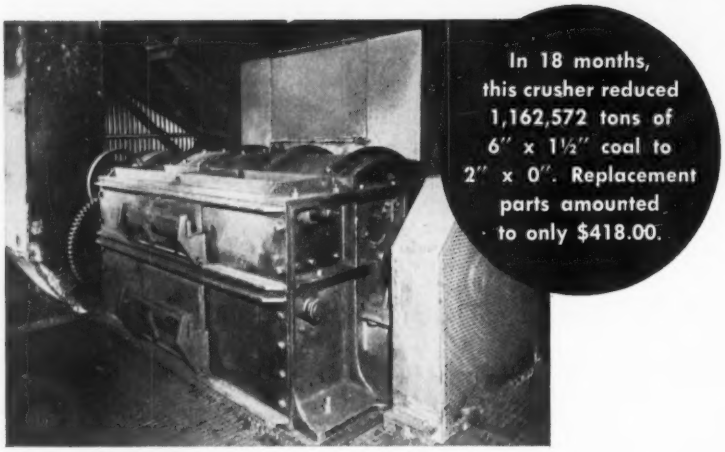
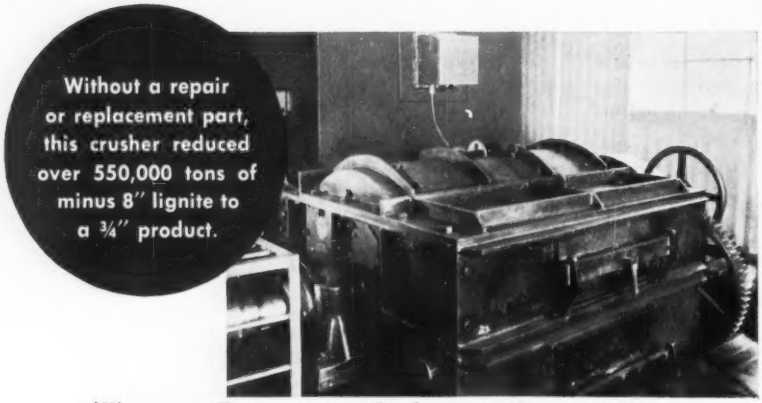
CRUSHING FACTS
on *American* COAL CRUSHERS







When you figure costs, the best results come from American Rolling Ring Crushers

American PULVERIZER COMPANY

ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

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Welding

Begins on page 270

472 **Submerged arc** and inert-gas welding wire is topic of 4-p folder DH-402B. American Chain & Cable Company, Inc, Page Steel & Wire Div

473 **Welding supplies** and accessories catalog has 52 pp. Illustrated with 100 photos, book covers fluxes, rods, electrode holders and lots of other equipment. Air Reduction Sales Company

474 **Stainless-steel welding** procedure is discussed in 54-p welding-fittings and flanges catalog TT600. Chemetron Corporation, Tube Turns Div

475 **Backing rings** are topic of 12-p spec sheet 58-2. Gives simplified welding procedure. The Robvon Backing Ring Co

476 **Wire-comparison chart** is topic of 4-p folder DH-1218-0. American Chain & Cable Company, Inc, Page Steel and Wire Div

477 **Special-purpose electrodes** for hard surfacing and stainless-steel welding are listed in 20-p catalog 7000-2. The Lincoln Electric Company

478 **Welding fittings and flanges** are described in 12-p booklet FB-78. Covers specs, analyses, effects of alloying elements. The Babcock & Wilcox Company

"Poor old Stan—I remember the day he tied the blowdown into the sanitary sewer."

TURBO-COMPRESSORS AND BLOWERS

2500 cfm and up

By Eugen P. Eicher, M.E., Brown Boveri Corp.

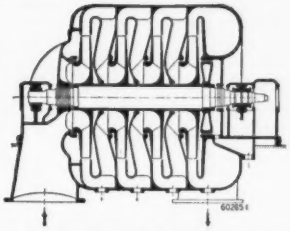
BROWN BOVERI

Brown Boveri offers complete compressor sets including compressor, choice of drives and all auxiliary equipment. Brown Boveri manufactures all the components, assembles and tests the complete sets in their own workshops and assumes full responsibility for the complete unit.

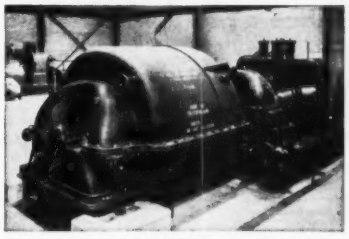
Compressors include a full range of centrifugal and axial types. Drives include steam turbines, gas turbines, expander turbines and electric motors. (Where hot waste gases are available, for example, a combination of motor-generator and exhaust-gas expander turbine drives has reduced power costs 60 to 70%.) Auxiliary equipment includes gear sets, pressure and volume regulators, air and gas coolers and complete electrical control systems.

Brown Boveri compressor sets are used by many leading U. S. companies and are backed by engineering skill, product reliability, and complete U. S. service staff and facilities.

2500 to 175,000 cfm at up to 60 psi* Uncooled centrifugal blowers



Four-stage centrifugal compressor.



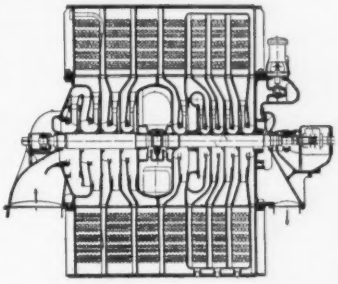
One of two 40,000 cfm centrifugal blowers with steam turbine drive in a copper conversion plant, Arizona.

First developed by Brown Boveri. Advantages over reciprocating compressors in the above ranges: lower cost, higher efficiency, less maintenance, less floor space and *clean, oil-free air.*

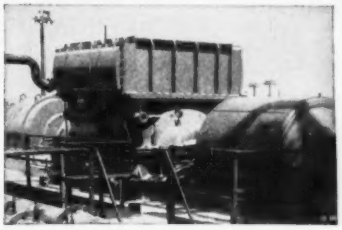
Standard designs are for air or non-poisonous, non-corrosive and non-explosive gases. Stainless steel impellers, shafts, etc. are available for corrosive gases. High-pressure casings and oil type sealing glands are available for higher pressures.

Applications: Blast furnaces, converters, coke ovens, gas distribution, process air and gases, air separation plants, sewage aeration, tunnel ventilation.

5000 to 80,000 cfm at 60 to 120 psi* Internally-cooled "Isotherm" centrifugal compressors



Nine-stage "Isotherm" compressor with anti-surge power-recovery turbine.



"Isotherm" compressor driven by a synchronous motor (left) and a waste-gas recovery turbine (right) at a California chemical plant.

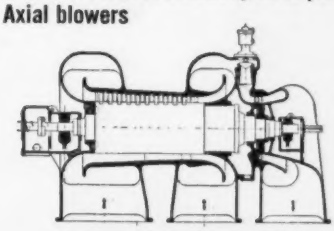
Highest inherent efficiency. Ten basic models with 6 to 9 stages per casing. Impeller diameters from approx. 1 ft. to 4 ft. The larger models include a built-in power-recovery turbine to allow running at loads below the surge limit.

Stainless steel impellers, shafts, etc. are available. For discharge pressures higher than 120 psi, "Isotherm" compressors are followed by an uncooled centrifugal compressor or other booster.

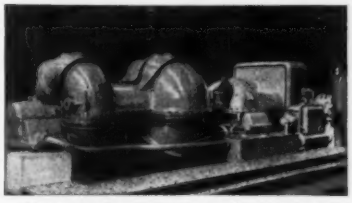
Drives: Four-pole synchronous motors are generally preferred for 1500 hp and larger units, other type motors for smaller sizes. Speed-increasing gears are used with all motor drives. Variable-speed steam or gas turbines are direct coupled.

The reliability of "Isotherm" compressors is proved by hundreds of installations in mines, shipyards, chemical process plants, air liquefying plants, aerodynamics laboratories.

10,000 to 500,000 cfm at up to 80 psi* Axial blowers



Ten-stage axial compressor with anti-surge power recovery turbine.



Axial blower, steam turbine drive, supplying 70,000 cfm of air for a blast furnace.

Substantially more efficient than centrifugal units for large air volumes where adequate pressure can be delivered with a single unit and without cooling. The higher efficiency allows smaller and better drives and lower cost. A power-recovery turbine may be built in to permit operation at volumes below the surge limit.

Drives. Steam turbines allow simple, automatic control through Brown Boveri pressure-oil governors with pressure or volume regulator. Brown Boveri gas turbines and electric motor drives of all types are also available.

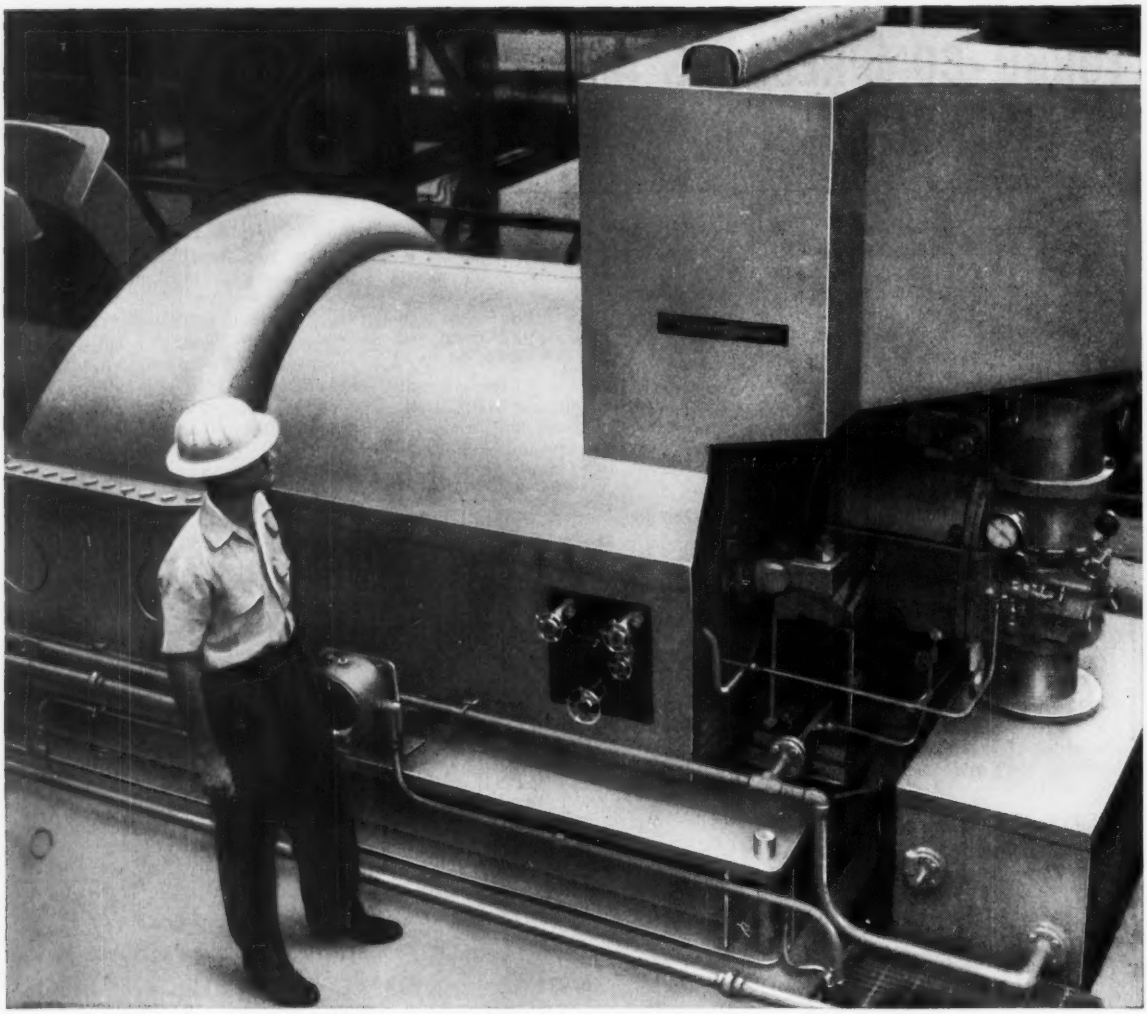
Applications: Gas turbines, wind tunnels and chemical plants. In Europe, Brown Boveri axial compressors driven by gas turbines are widely used for blast furnace air with substantial power savings.

**Capacities for single machines. Higher discharge pressures can be obtained by combining various types of equipment in series.*

BROWN BOVERI

U. S. Sales and Engineering: Brown Boveri Corp., Dept P-10, 19 Rector Street, New York 6, N. Y. Agents in 27 U. S. cities.

For more facts circle 921 on Reader Service card, p 227



Westinghouse multi-stage, hi-speed turbines guarantee you

...engineered power to meet your exact needs

Why pay for power you can't use? Or, by the same token, why strain a machine beyond its capability? Westinghouse can meet your exact turbine requirements with the world's broadest line of wheel sizes and design capabilities for steam conditions through 2400 psig—1050° F at the throttle, exhausting from 1 in.hg absolute to 300 psig.*

Fitting the right wheel size to the job is the key to efficiency and economy. By knowing your process requirements, cost of steam and number of hours you expect your turbine to run during the "payoff" period, we can provide the turbine design best suited to your power and economic requirements.

To meet these varied requirements, Westinghouse has available five frame sizes of multi-stage, hi-speed turbines with wheel diameters ranging from 12 in. to 32 in. In addition, interchangeability of many wearing parts saves you money on inventories and stocking of spare parts.

Westinghouse turbine specialists located throughout the country are available at all times to provide personal attention to your heat balance problems, and are equipped to offer on-the-spot price and performance data for this entire turbine line. The capabilities of the world's largest and most modern small turbine facility are at your disposal. Call your Westinghouse representative, or write Westinghouse Electric Corporation, Small Turbine Sales, Lester Branch Post Office, Philadelphia 13, Pennsylvania. J-50605

***WESTINGHOUSE MULTI-STAGE, MULTI-VALVE, HI-SPEED TURBINE FRAME CAPABILITIES**

Turbine Frame	M-12	M-16	M-20	M-25	M-32
Number of Stages	.....	.....	As Required	.....	.....
Wheel Size, in.	12½	16	20	25	32
Maximum hp	4000	5000	7000	10,000	16,000
Maximum rpm	16,000	12,500	10,000	8000	6000
Maximum P_1, psig	1500	1500	1500	1500	1500
Maximum T_1, °FIT	950	950	950	950	950
Maximum P_3, psig	300	300	300	300	50
Exhaust Size, in.	20	24	30	36	48
D. F. Exh. Size, in.	30	36	48	42 x 64½	48 x 84
Max. Inlet Size, in.	5	6	8	10	12

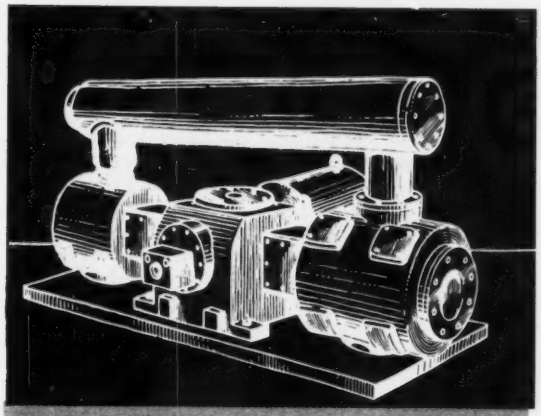
(For special applications, inlet steam conditions to 2400 psig, 1050° F total temperature can be accommodated.)

YOU CAN BE SURE...IF IT'S

Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV FRIDAYS

COMPRESSORS and ACCESSORIES



Compressed-air requirements continue to grow with increased industrial and power-plant needs. High-speed centrifugals are in use in large central stations supplying all air requirements by taking bleeds at various pressures—90-psi instrument, 100-psi plant service and 300-psi sootblowing. For industrial use, 1000-cfm oil-free air compressors are available. A variety of higher capacity, portable, engine-driven machines meet increased air requirements. Low speeds and oversized drives increase reliability and service life of rotary and reciprocating air compressors.

F. W. Edwards

Assistant Editor

New equipment designs: Circle key numbers on Reader Service card, p 227, to get complete product story

110 **Single-stage compressor** is economical to operate and maintain—low engine speed reduces wear. Unit is reported to combine single-stage simplicity with 2-stage economy because engine and compressor reach peak efficiency at 1800 rpm. The 168-hp gasoline engine has over 50% reserve capacity, maker states. Worthington Corporation, Holyoke Div

111 **Capacity almost 20% greater** than previous model is offered by 250-cfm portable rotary compressor. Larger, more powerful engine retains its predecessor's 1800-rpm speed. Diesel or gasoline engine is available. Fuel and air tanks are under housing, with a lockable cover. Order this compressor in 2- or 4-wheel mounting.—Ingersoll-Rand Company

112 **A 4-cylinder engine** and 2-cylinder air compressor are built as one model in this compact unit. Single-stage, piston type portable compressor boasts 125-cu-ft-per-min capacity, speed of 1300 rpm. A 3-point suspension system protects against towing distortion.—Westinghouse Air Brake Company, Le Roi Div

113 **Improved compressor blades** are made of special solid, lightweight material for improved wear resistance. Low weight, minimum friction reduce hp requirements. Compressors with displacements of 8 to 650 cfm in 2- to 125-hp sizes, pressures to 125 psig are available.—Davey Compressor Company

Free design aids: Yours for the asking. Circle key numbers on Reader Service card, page 227, to get your copies

479 **Air-cooled compressors** in 15- to 125-hp, 81- to 641-cfm range are subject of 16-p bulletin A-56. Joy Manufacturing Co

480 **Heavy-duty** industrial compressors, in six sizes from 350 to 1250 hp, 2418 to 7392 cfm are covered in 12-p bulletin A-73. Joy Manufacturing Company

481 **Portable 125-cfm** rotary compressor is discussed in 4-p folder 2930. Photos detail features. Ingersoll-Rand Company

482 **Horizontal water-cooled** single-stage heavy-duty compressors are illustrated in 8-p bulletin 350. Pennsylvania Pump and

483 scribed in 20-p bulletin 909. Decompressor Company
Centrifugal compressors are details construction, operating features, typical applications. Informative book also includes photos, graphs, cutaways. American-Standard Industrial Div

484 **Heavy-duty 1-p compressors** ranging from 756 to 7392 cfm are topic of 8-p bulletin A-95. Includes a detailed sectional drawing. Joy Manufacturing Company

485 **Industrial compressor,** 100-hp model, is subject of 4-p bulletin E-274. Unit delivers 420 cfm at 100 psi. Davey Compressor Co

486 **Portable rotary compressor,** 250-cfm model, is described in 4-p bulletin 2931. Ingersoll-Rand Company

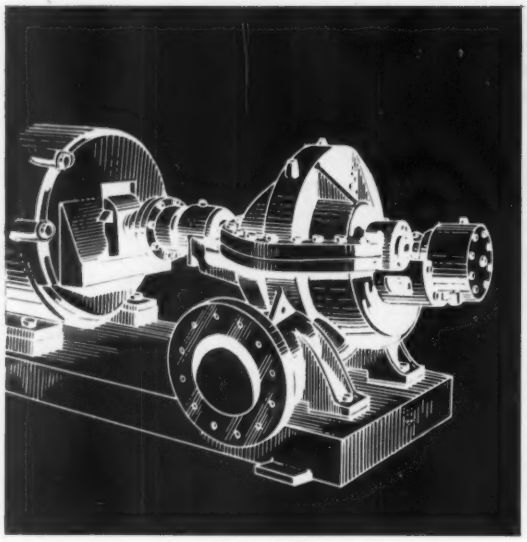
487 **Single- and 2-stage** air compressors from ½ to 15 hp and 80 to 250 psi are covered in 12-p bulletin SG-2. Westinghouse Air Brake Co, Le Roi Div

488 **Gas turbine-compressors** are featured in 12-p illustrated bulletin P-10. Turbine operates at temperatures to 1250 F; compressor range is 30 to 200 psig. Elliott Company

489 **Air compressor** is described in 24-p bulletin A-62. Gives specifications chart, installation photos, cross-sectional drawings, diagrams. Joy Manufacturing Company

490 **Oil-free** compressors for heavy-duty industrial use are subject of 12-p bulletin A-44. Units boast capacities from 95.6 to 939 cfm. Joy Manufacturing Company

PUMPS



Advances in every industrial and power area have made necessary the development of many new pump designs. Circulating hot-water heating systems are becoming more and more popular in large industrial and service facilities. Temperatures and pressures are both climbing over the 500 mark. For pipeline booster service a pump can be located right inside the pipe, suspended by spiders —it needs no cooling or protective structure. Ever-increasing boiler-feed pump horsepower requirements in large central steam stations have pointed the way to increased use of turbine-generator drive. Several control arrangements will shortly be in actual operation.

F. W. Edwards

Assistant Editor

Recent equipment developments: Circle key numbers on Reader Service card, page 227, for additional info

114 **Low-cost controlled-volume pump** handles clear and corrosive liquids for chemical processes. Job-engineered for metering situations demanding durability and accuracy, it's reported to be rugged, economical. In field and lab tests model *CM* delivers maximum capacity of 28 gph in simplex design, double that in duplex, at pressures up to 1100 psi. Screwed gland packing promises flexibility; pump is made of steel and 316 stainless steel. Simplified construction features plungers interchangeable within pump frame—you can convert this unit from simplex to duplex in the field.—Milton Roy Company

115 **Streamlined, functional safety shield** covers a compact arrangement of components in this revamped proportioning and metering pump. Unit accurately delivers payloads through a range from a fraction to 1030 gph per feed. Four look-alike models have interchangeable parts to cut inventories and cure your maintenance headaches. Improved drive mechanism has connecting rods extending only nine deg from axis of plunger, holding eccentric load to a minimum. Hills-McCanna Company

116 **Controlled-capacity metering pumps** handle lab and industrial service. Line includes plunger and diaphragm type units, both operating on reciprocating action of positive-displacement plunger. Convert one type to the other simply by switching liquid-end assemblies. Capacities range from one drop per 13 strokes to 1000 gph.—The Clark-Cooper Company, Inc

117 **Proportioning pump** for water treatment and process is packaged, with pump, suction and discharge tubing, injection nozzle, foot valve, tools and spare parts ready for use wherever precise chemical feed is needed. Electrically driven positive-displacement unit has corrosion-resistant transparent plastic head, Hypalon diaphragm and check valves and a straight-through flow design, so it can meter acids or alkalies efficiently. Simplex model proportions up to 12 gph with discharge pressures to 125 psi.—B-I-F Industries, Inc

118 **Packaged proportioning pumps** and feeder tanks provide economy and convenience; one phase of installation piping is completely eliminated. Pumps are controlled-capacity units with capacities from .65 to 13.10 gph at 1000 psi in the simplex model. Design highlights are accurate screw type stroke adjustments, spherical self-aligning bearings on crank and crosshead.—American Meter Company, Pump Div

119 **Controlled-volume pumps** use minimum of working parts and bearing surfaces to translate high-speed rotary motion into low-speed reciprocating motion. Designed for the chemical-processing industries, pumps boast integral, totally enclosed speed reducer running in an oil bath. Maximum capacity is 29 gph, which can be adjusted by hand or automatically from 0 to 100% with pump in operation. Pumps will meter against pressures to 1900 psi.—Milton Roy Company

120 **Plunger type** small-capacity proportioning pump is designed for small l-p boiler chemical treatment. It operates on 110 v, 60 cycles, has built-in reduction gear box and thermal-overload protection. Adjustable stroke length gives feed rates from 0.2 to 2 gph into a 300-lb maximum discharge pressure.—B-I-F Industries, Inc

121 **Air-operated free-piston pump** has no moving parts, needs no lube. It is reported to be noiseless and vibrationless, moves anything that flows without pulsating, surging or contamination. Capacity, about 100 gpm of water, is governed by air pressure available, size of inlets and outlets.—Crossley Machine Company

122 **Glass, stainless steel** or other corrosion-resistant metal is available for liquid ends of these tripod-mounted vertical centrifugal process pumps. Metal-end pumps in capacities to 800 gpm handle highly volatile, inflammable, toxic or explosive liquids where pumpage must be isolated from atmosphere. They can also pump liquids at high or low temperatures, −320 to +550 F, and are designed with closed adapter and column so that pressurized inert gas or clear compatible liquid can be introduced. Use the glassed-end pumps in capacities to 700 gpm with corrosive liquids or where metal contamination must be prevented.—Goulds Pumps, Inc

123 **Hot-water circulation** and all types of process applications are tackled by two new pumps. Enclosed-impeller centrifugal model *3775* pumps up to 850 gpm at maximum working temperature of 600 F, top pressure of 550 lb. Model *3675* is close-coupled, also rated 850 gpm. Limits for this pump model are 275 F, 275 lb.—Goulds Pumps, Inc

124 **High-pressure** low-capacity variable-volume reciprocating plunger pumps feed as little as 1.5, as much as 108 gph. They take corrosive or noncorrosive liquids in their stride as they bid for chemical-process, food-process and water-treatment duties. Standard models handle up to 625 psi, special models extend range to several thousand psi.—Walter H Eagan Co, Inc

125 **Hard-to-handle slurries** or solutions are no problem to this controlled-volume pump, maker states. Inclined pump chamber automatically eliminates entrained air from body, double-ball check assemblies provide high metering accuracy. Units handle abrasive slurries with 60% solids, deliver them at pressures up to 90 psi.—Milton Roy Company

126 **Positive-displacement** inherently self-priming pump maintains capacity requirements over a wide range of heads. Suction lift up to 30 ft at speeds between 750 and 3000 rpm is available, with reasonably constant capacity maintained at any speed at pressures from 0 to 100 psi. Engaging surfaces are rubber-to-metal, promising good service in handling corrosive and abrasive liquids, according to maker. Only lube is liquid being pumped.—Goodyear Pumps Inc

127 **Compact packaged turbine pump** handles medium-volume high-pressure boiler-feed and general service. It comes complete with all controls for constant- or differential-pressure regulation. Single-stage design has reported capacity of 180 gpm, discharge pressures up to 350 psig.—Coffin Turbo Pump Co

128 **Compact triplex power pump** boasts extreme versatility—petroleum, chemical, hydraulic-system or general applications are all within its scope. Reported high output of 10-hp continuous, 12½ hp for a 10-hr day is combined with low cost. Continuous plunger load rating at normal hp is 1100 lb, which increases to 1375 lb for intermediate service. Horizontal unit is compact, easily installed.—Union Steam Pump Co

129 **Lightweight self-priming pump** is powered by a 9-hp engine, standard-equipped with exhaust-valve rotor. Use it to pump 22,000 gph of water from excavations, elevator shafts and manholes, as well as for general low-cost utility pumping. Simplified design cuts out troublesome check and suction-hose foot valves and all paper gaskets. Model *30-T* comes with convenient carrying handles, mounted on wheels or in a wrap-around protective frame.—Hale Fire Pump Company

130 **Heaviest slurries** of sand, coal, tailings, crystals, chemical sludges or abrasive plant drainage are peanuts to this rugged pump, designed for submerged wet-pit sump service. Maker claims low speed and continuous duty with heavy and fine slurries for type *RXV*. The unit is quickly dismantled, since only four bolts clamp its liquid end. It's designed without stuffing box or vapor binder.—Morris Machine Works

131 **Horizontal pipeline booster pump** operates within the pipe itself to provide noiseless operation, economy and dependability. You don't need to build a pump house, and unit is guarded against motor damage from heat, dust, moisture. Suspended in a special section of pipeline, centered and held by spiders, pump draws from 100 to 4000 gpm into its bowl assembly, passes it along at greatly increased pressure.—Layne & Bowler Pump Co

132 **Ceramic-coated seal,** standard equipment on these self-priming pumps, is said to last five times longer than iron-bronze seal, fifteen times longer under highly abrasive pumping conditions. The 3-in. pumps feature capacities running to 18,000 gph. Rugged 2-cycle engine, self-cleaning construction are other high points.—Textron Inc, Homelite Div

133 **High-head centrifugal pumps** are available in 1½- through 6-in. sizes with base mounting, pneumatic tires or steel wheels. Self priming, they can be belt, flexible-coupling or direct-connected engine driven.—Rice Pump & Machinery Company

134 **Centrifugal pump** handles abrasive slurries of cement, sand, coal, solids, chemical sludges and plant wastes. Type *RX*, in 2- to 6-in. sizes, features suction and discharge nozzles that swivel to fit any installation.—Morris Machine Works

Latest pump design aids: Just circle the key numbers on Reader Service card, p 227, for more information

491 **Proportioning feeder** is topic of 4-p bulletin 1140.20A-1. Cutaways show fluid-end construction. B-I-F Industries, Inc

492 **Reciprocating pumps** for chemical proportioning and power service are subject of catalog 758. Jaeco Pump Company

493 **Rotary pumps** are featured in 12-p bulletin 278. Lists performance and installation data. Roper Hydraulics, Inc

494 **Canned pumps** for the nuclear industry are discussed in informative 7-p technical bulletin 4. Chempump Corp

495 **Reactor-system pumps** for high pressures and temperatures are

subject of bulletin PR-2. Food Machinery and Chemical Corporation, Peerless Pump Div

496 **Motor pumps** in 20 sizes for off-the-shelf delivery are described in 8-p bulletin 70022. Ingersoll-Rand Company

497 **Power-driven pumps** are covered in 24-p bulletin 20. Shows complete line of 10- to 1580-gpm capacities. Includes 19 tables. Blackmer Pump Company

498 **Centrifugal pumps,** single-stage double-suction with horizontally split cases, are topic of 16-p bulletin 721.6. Gives sectionals, charts, specs. Goulds Pumps, Inc

499 **Pumps for metering chemicals** in minute volumes against pressure are described in 4-p bulletin 1257-1. Milton Roy Company

500 **Metering pumps** are subject of handy 6-p folder 900. Hills-McCanna Company

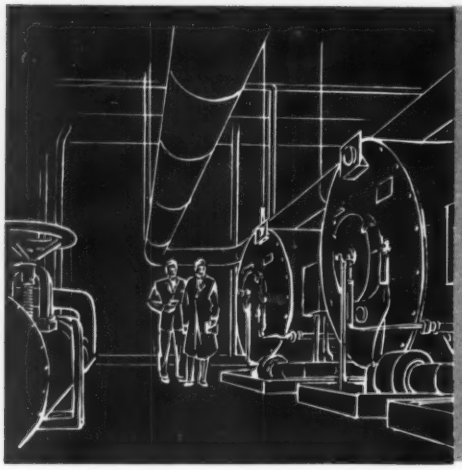
501 **Fire and booster pumps** are described in 10-p bulletin 08B9032 and 4-p 08B8551. Shows centrifugal double-suction single-stage units approved for heads from 50 to 145 psi, capacities from 500 to 2500 gpm. Includes illustrations. Allis-Chalmers Manufacturing Company

502 **Herringbone gear pumps** are covered in 4-p bulletin G-1. Includes dimensional data, driving power requirements. Schutte and Koerting Company

503 **Turbine pumps,** vertical ultra-high-flow type, are discussed in 16-p bulletin 2400-B1. Illustrates design features. Worthington Corporation

504 **Single-stage** side-suction centrifugal pumps are covered in

STEAM GENERATION



In the industrial field packaged steam-generating unit installations continue to outnumber field-erected units and are taking over a larger share of total installed capacity. Indications are that this trend will continue as boiler manufacturers pack more and more capacity into their compact, relatively small-volume units. Teaming up with the boiler people, controls and firing-equipment designers and associated equipment manufacturers are supplying components which give the completed units top performance characteristics with lower-than-ever maintenance costs.

In general, trend is to higher steam temperatures and pressures, though some process industries (particularly plastics) are turning to thermal-liquid schemes to get needed temperatures without paying penalties involved in high-pressure systems.

Associate Editor

New steam-generation equipment: For data on these items, circle numbers on Reader Service card, p 227

135 **Packaged steam generator** uses a thermal liquid that's vented to atmosphere, so it's considered an unfired pressure vessel. Thermal liquid is heated by oil or gas and circulated through a heat exchanger to generate steam up to 600 psi, water to 450 F. You can locate the heat exchanger in the factory, remove high pressure from the boilerhouse. Generator uses nonflammable, stable, noncorrosive thermal liquids. Operation is reported to be simpler than conventional h-p steam boiler—h-p steam outlet is on top of steam drum and condensate return and makeup enter at drum's bottom. Gages mount on steam drum.—American Hydrotherm Corp, Thermal Systems Div

136 **Dry-land adaptation** of a marine steam generator produces 5000 lb per hr in 8x7-ft floor space. Oil-pump-set assembly is factory-installed under the boiler, water-treatment tanks mount on side of shell.—National-U.S. Radiator Corporation, Cyclotherm Div

137 **King-sized packaged boilers** generate 100,000 lb steam per hour. Natural-circulation units bid for electric-utility posts, may cost 20% less than field-erected models. Boilers operate at steam pressures of 250 to 775 psi. They'll burn oil, gas or a combination. Notable feature is drainable superheater; this ease of draining permits fast, safe startup, maker claims.—The Babcock & Wilcox Company

138 **Packaged watertube boiler** produces 4000 to 13,000 lb steam per hr. You get efficient heat transfer without baffles or gas-collecting pockets. Tangent tubes in furnace wall eliminate refractory baffle between furnace and convection tube pass of boiler, according to the maker. Standard rotary burners give you automatic operation, maximum safety.—Superior Combustion Industries, Inc

139 **Packaged firetube boilers** are available for high- or low-pressure steam. They fire oil, gas or a combination. One feature is 4-pass forced-draft construction, said to give high flue-gas velocity and 80% efficiency, cut tube cleaning.—Cleaver-Brooks Company

140 **Packaged efficiency and simplicity,** field-erected steaming capacities combine in this firetube giant—you get

8-p bulletin 720.4. Includes specs, sectional view, dimensional chart, performance curves. Goulds Pumps, Inc

505 **Bulk-handling** rotary pumps are topic of bulletin 100. Includes tables, selection info, cutaways. Blackmer Pump Company

506 **Ball-bearing** horizontally split case double-suction centrifugal water pumps are detailed in 6-p bulletin 251. Warren Pumps, Inc

507 **Pumps for water** and nonabrasive liquids at rates to 70,000 gpm are listed in bulletin B-1300. Food Machinery and Chemical Corporation, Peerless Pump Div

508 **Heavy-duty rotary pumps** are described in bulletin 170. Basic types have internal or external rolling-contact bearings or jacketed head, according to maker. Blackmer Pump Company

509 **Screw pumps** rated 1 to 2000 gpm are discussed and illustrated in 6-p bulletin S1-6. Sier-Bath Gear & Pump Co

510 **Nuclear pumps,** liquid-metal, mechanically sealed and other types, are topic of 4-p bulletin. Byron Jackson Pumps, Inc

511 **Utility pumps** with helical screws are covered in 8-p catalog. Only moving part in the pumps is a rubber stator. Continental Pump Company

512 **Proportioning pumps** are featured in catalog 100. American Meter Company, Pump Div

513 **Proportioning** at low pressure and atmospheric discharge is discussed in 4-p reprint RP-1106-2. B-I-F Industries, Inc

26,000 lb steam per hr at 20% efficiency or better down to a small fraction of rated capacity. Boiler measures 28x9½x10½ ft. It burns heavy oil or gas or adapts to l-p gas or light oil.—National-U.S. Radiator Corporation, Cyclotherm Div

141 **Air-atomizing oil burners** and ring type gas burners are new features of revamped packaged-boiler line. Both types of burners promise stable, uniform flame patterns. They'll burn all grades cleanly at extremely low noise levels, modulating range of 5:1. Now available in intermediate sizes with larger units to come, model *AA* boiler has smaller motors and preheaters to cut operating costs.—Ames Iron Works, Inc

142 **Latest electronic** safety and operating controls are built into inverted forced-draft pressure burners. You can apply them to Scotch marine boilers and they'll burn oil, gas and combinations. Capacities range from 7 to 30 gph of oil, 1,000,000 to 4,200,000 Btu per hr of gas.—Ray Oil Burner Company

143 **Venturi torch burners** give you a wide range of heat control for industrial or process heating equipment such as furnaces, air heaters, ovens. They offer 10:1 turndown with l-p gas, 16:1 with 10-psi gas. The 2½-in. size provides 1,500,000 Btu per hr with 10-psi gas at high fire.—Bryant Industrial Service Co

144 **Use this Scotch-boiler burner** where you have backpressure or positive furnace pressure. Five standard models range from 1,000,000- to 5,000,000-Btu capacity. Model *TF-1* burns 1,000,000 Btu against .5 in.-wc backpressure.—The Mettler Company, Inc

145 **Steam-atomizing burner** is adapted to packaged firetube boilers, lets them burn low-cost heavy oils, bunker C and No. 6. System uses steam from boiler at 40 psi to break fuel oil into a fine mist—air atomization is used at startup. Steam atomization has these reported advantages: clean, complete combustion, clean nozzle on shutdown.—Orr & Sembower, Inc

146 **Packaged f-d burners** are used on multiple-pass Scotch marine, watertube and firebox boilers plus other types of pressurized heat receivers. Small-capacity rotary units are factory assembled, wired and tested. They feature electronic control.—Ray Burner Company

147 **New concept** in steam generation uses centrifugal action and high velocity to speed transfer. Disk-like tubular heat exchanger rotates at several thousand rpm. This sucks pre-mixed gas and air into annular burner plate, and high relative velocity between gases gives high heat transfer. This generator packs a lot of power into less than two cu ft of space, produces 300,000 Btu per hr, can deliver 100-psi steam in 20 seconds. Lightweight, portable, it handles fluids for heating, cooling, vaporization and condensation.—Beltran Associates, Inc

148 **Generate steam** for cleaning and thawing where you need it with this compact portable boiler. Two models with outputs of 1380 and 1725 lb steam per hr at 212 F weigh about 5000 lb each. They measure 15x4x5½ ft, come mounted on a low carriage with hard-rubber tires for towing ease. Attached makeup tank holds seven or eight hours' worth—80 gal. Rugged firetube design, weatherized construction make this boiler ideal for hard outdoor use, says the maker.—Cleaver-Brooks Company

149 **Improved differential-drainage** and boiler-return system gives you better performance with lower operating and maintenance costs, maker reports. System meets need wherever steam is used for process at 30 psi or more. New features are a 2-stage pump to replace dual-pump setup formerly used, a floatless liquid-level control, chrome-plated pump internals, Teflon packing in the differential valve. System returns condensate from steam-processing units to boiler at 300 F or higher, only 15 to 20 F less than operating-pressure temperature. Fuel cost may be lowered 10 to 25% by this system, according to the manufacturer.—Stickle Steam Specialties Co

150 **Unique air-cooling system** trims fuel and stack-maintenance costs in these specially designed i-d fans. Radiant-heat cover installed between bearing and fan housing is said to help fan maintain constant, controlled overfire draft, increasing combustion efficiency and eliminating need for large stacks. Unit handles combustion gases up to 800 F.—Fuller Co, Lehigh Fan & Blower Div

151 **Irregularly shaped steel shot** are cascaded through tubular air heaters, over horizontal surfaces such as

superheaters, economizers and reheaters, removing ash and soot. Boiler shot-cleaning system drops shot by thousands, spreads them evenly so they cascade and ricochet uniformly, removing deposits in small particles. Most of loosened ash is carried away by gas stream, heavier particles fall into hopper, recirculate with shot until broken fine enough to pass out with the gas.—Diamond Power Specialty Corporation

152 **High-impact air vibrator** is designed for electrostatic precipitators and dust collectors, has 1-piece construction for heavy duty. Weighing 52 lb, it is reported to practically eliminate collector maintenance problems.—National Air Vibrator Company

153 **Designed for pressurized firing,** small-size packaged boiler has 2-pass design to assure maximum thermal efficiency of 80% or over, maker reports. Oil- or gas-fired unit is 57-in. high with outside diameter of 41 in., length of 85 or 96 in.—Dominion Bridge Company, Ltd

154 **Boiler-return system** features clean modern lines, with pump, motor and tank packaged as a single unit. All gages, valves, vent and return openings are in place ready to pipe, and low-npsh pump saves you headroom. Systems come in 50, 80 and 130-gal capacities with centrifugal or turbine pumps, the manufacturer reports.—Liqui-Therm Products, Inc

155 **New feedwater heater** features an internal-vent condenser. Double-walled hood at heater's top has opposing fins on inside walls to slow, condense the rising steam. Air and noncondensable gases escape to atmosphere through air-vent valve. These units range from 3000 to 300,000 lb per hr, according to the manufacturer.—Stickle Steam Specialties Co

Steam-generation design aids: Circle key numbers on handy Reader Service card, p 227, to get your copies

514 **Packaged deaerating heater** for the smaller steam-generating plant comes in capacities from 2800 to 100,000 lb per hr—6-p bulletin WC-118A gives details. Graver Water Conditioning Co

515 **Deaerating** feedwater heaters, baffle-spray units, are topic of 6-p bulletin S-217. Stickle Steam Specialties Co

516 **Boiler cleaning** is described in 4-p bulletin. On-the-job photos help tell the story. Breuer Electric Mfg Co

517 **Underfeed stoker** applications guide GS-1, 58 pp, concerns stoker applications to boilers. Includes drawings of layouts, specs. Bituminous Coal Institute

518 **Automatic fuel burner** is topic of 8-p brochure 430B. Includes installation photos, features. Peabody Engineering Corporation

519 **Industrial burners** with built-in fuel and air systems are subject of 4-p folder 5807. Iron Fireman Manufacturing Company

520 **Underfeed stoker** with double-retort feature is built for boilers of 20,000 to 34,000 lb per hr—8-p catalog 401 fills in details. Detroit Stoker Company

521 **Low-cost flyash-handling** methods using pneumatic conveyors are studied in 16-p bulletin FF-49-1. Fuller Company

522 **Induced-draft fans** are described in 16-p bulletin L-3. Fully dimensioned drawings, rating charts and specs give details on the i-d units. Fuller Co, Lehigh Fan & Blower Div

523 **Tray type deaerating heaters** are covered in 12-p bulletin WC-106A. Discusses principles of operation. Graver Water Conditioning Co

524 **Fuel-burning system** is topic of 8-p 4-color bulletin 1255. Oil, gas and combination burners are listed. Orr & Sembower, Inc

525 **Vortex burners** in six standard models are detailed in 4-p bulletin 116. Thermal Research & Engineering Corp

526 **Induced-draft fans** help improve fuel efficiency, according to informative 4-p bulletin L-1A. Fuller Company, Lehigh Fan & Blower Div

527 **Mechanical pressure** atomizing oil-fired and partial premixing gas-fired packaged boilers are discussed in 8-p bulletin 1250. Orr & Sembower, Inc

528 **Refractory cements** to keep down industrial-furnace maintenance costs are topic of 16-p booklet. Mexico Refractories Company

529 **Horizontal boiler** for use with gas, oil or gas and oil is discussed in 4-p booklet 8-C. Mears-Kane-Ofeldt, Inc

530 **Boiler guide** for engineers is a 20-p pamphlet with over 30 illustrations and graphs. Covers costs, fuel, space, burner efficiency. Cleaver-Brooks Company

531 **Packaged boilers** are covered in 4-p brochure PG-58-2. Foster Wheeler Corporation

532 **Packaged f-d firing systems** are illustrated in 4-p bulletin 5843. Iron Fireman Manufacturing Company

533 **Firetube 2-pass** packaged boilers are subject of 4-p bulletin BE-100. Boiler Engineering & Supply Co, Inc

534 **Rotary f-d** and pressure f-d 3-pass packaged boilers are subject of 8-p bulletin 34-B-1. Webco Boiler Co, Inc

535 **Horizontal rotary burners** are topic of 4-p bulletin 415. Preferred Utilities Manufacturing Corporation

536 **Packaged automatic** hot-water boilers rated from 500,000 up to 20,000,000 Btu per hr are topic of informative 8-p bulletin 1251. Orr & Sembower, Inc

537 **Boilers and accessories** are described in 20-p catalog SB-60. Cross sections show design, construction. Erie City Iron Works

538 **Water-cooled** rear combustion chamber is feature of this packaged boiler—4-p bulletin 200 gives details on the unit. Johnston Brothers, Inc

539 **Packaged steam generators** are shown in 6-p folder. Includes spec sheets on hot-water generators. National-U.S. Radiator Corporation, Cyclotherm Div

VALVES, PIPING, FITTINGS AND SPECIALTIES

Progress in valves, piping, fittings and specialties has been marked by improvement of standard products, rather than production of exotic new equipment. Extended pressure and temperature ratings for standard lines, easier maintenance and better operation are typical of this year's developments. Lighter fittings available for noncritical applications may be cost-saving items.

Introduction of plastics into the valve, piping and fitting field (see POWER, September 1959, pp 65-70) has eased many thorny problems of the past. Except in high-temperature and pressure applications, plastic pipe finds wide usage, especially where certain corrosion problems exist. Light weight and ease of field assembly reduce installation labor and cost. But standards are needed on sizes and working stresses.

V. W. Edwards

Assistant Editor

This year's new equipment: Circle key numbers on Reader Service card, page 227, to get more information

VALVES

156 **Butterfly valve** allows you to adjust seat-retaining pressure externally with valve in place in the line. Only two seat-retaining screws are used and these are kept out of contact with the flowing medium to avoid any corrosion problem. Valves fit line sizes from 6 to 48 in., maximum line velocity of 8 or 16 fps, maximum shutoff pressures of 25, 50 or 125 psi.—F B Leopold Company, Inc

157 **Steel check valves** provide high-temperature hot-water service. When forward flow stops the spring-actuated units close automatically, eliminating surge, hammer and backdrop. Install them in any position, to handle fluids at pressures from 150 to 2500 psi, all temperatures.—Combination Pump Valve Company

158 **Leakproof valve** has no moving parts between fluid chamber and atmosphere, so you can use it for radioactive toxic fluids. Working temperatures are −20 to +1500 F, pressures from 0.005 microns vacuum to 150 psig in smaller sizes, up to 30 psig in sizes to 72-in. dia.—Singmaster & Breyer

159 **Screw-stem shutoff valves** prevent leakage to atmosphere and viscous-fluid clogging of activating threads. Standard models handle fuel oil, gasoline, kerosene, acids or alkalies at −40 to +250 F, up to 500 psi.—Anderson Brass Company

160 **Crankcase explosion-relief valve** is useful with heavy-oil or gas engines. Effective flame traps protect personnel—internally oil-wet wire gauze is said to absorb more heat before allowing passage of flame.—The Pyropress Engineering Company Ltd

161 **In a telescopic arrangement,** soft-rubber cup is forced to concave bottom of this all-plastic valve's passage. Under pressure from stem, flexible cup seals on all sides, positively shutting off fluid flow. Foreign matter is said to be accommodated without damage or loss of sealing. The 1- to 4-in. units are rated for 145-psi working pressure—W S Rockwell Company

162 **Flow regulator** automatically permits a specified flow rate regardless of inlet pressure. Unusual design means low pressure drop, maker states. Flow tolerances are maintained to 180 psi, temperatures to 160 F by this regulator.—Hays Manufacturing Company, Automatic Controls Div

163 **Globe valves for steam,** oil, water and gas lines have disks made of chromium-cobalt-tungsten stainless-steel alloy for longer wear under continuous high pressures. They're rated 600 psi at 910 F in carbon steel.—Edward Valves, Inc

164 **Needle valve** throttles, regulates, shuts off. It features a forged carbon-steel body, back-seating construction for repacking under pressure. Maximum working pressure for the unit is 10,000 psi at 70 F, maker states.—Kerotest Manufacturing Company

165 **Nonlubricated valve** uses two Teflon O-rings. Unit double-blocks and bleeds in most services to do the job of two ordinary valves, maker states.—Stockham Valves & Fittings.

166 **Large-ratio valve** reduces 6000 to 100 psi, to within 20% of initial pressure in one stage. Small air reducing and relief valve charges a diaphragm chamber to control the reduced pressure. Valve adapts to air, gas or hydraulic operation.—Atlas Valve Company

167 **General-purpose leakproof shutoff valve** has three ports arranged as 3-way valves to provide one inlet, one outlet and an exhaust. Sealing with O-rings on face of cylindrical plug and on plug's diameter is reported to produce easy operation, low maintenance.—Circle Seal Products Company

168 **Bronze gate valve** provides tight shutoff against flow from either direction. Ball-and-socket joint between

self-adjusting disk faces, accurate guiding are features said to insure flexibility for pressure-tight seating. Sizes are ½- to 4-in.—Lunkenheimer Co

169 **Direct-operated reducing valve** controls steam pressures for a variety of plant applications. Ports minimize falloff; an isolated diaphragm chamber gives maximum stability. Lightweight unit comes in ½- to 1-in. sizes in iron construction.—Worthington Corporation, Mason-Neilan Div

170 **Penton,** a chemically resistant chlorinated polyether that can take temperatures up to 300 F, lines these ½- to 6-in. processing valves. Bodies are cast iron or aluminum. Units are compatible with glass, plastic, metallic and lined piping.—Hills-McCanna Company

171 **Made to fit** line sizes from 4 to 48 in., 125-lb butterfly valves see service as replacement units, for pressure reducing and throttling functions, for street shutoff, pump discharge, distribution systems. They can be supported by the line, eliminating special construction.—B-I-F Industries, Inc

172 **Positive shutoff** is accomplished with a spring-loaded long-lasting rubber plug in this "stopple" valve. In closed position valve plug is held in place by line pressure and spring load. Units have steel bodies, ¾-in.-npt outlets.—Rutherford Company, Inc

173 **Union-bonnet gate valve** permits frequent dismantling and reassembly for inspection and service. Rising-stem valves are made in sizes from ¼ to 3 in.—Ohio Brass Company

174 **Stainless-steel plug valves** come in 4- and 5-port models to handle everything from hard-to-hold light gases and solvents to heavy slurries and corrosive liquids, maker states. Nonlube feature prevents stream contamination. Use these valves for 150 to 400 F, pressures from high vacuum to 275 psi depending on temperature.—Continental Manufacturing Company

PIPING, FITTINGS, SPECIALTIES

175 **U-bend heat-exchanger tube** now comes direct from manufacturer, factory-fabricated to many standard and custom gages, diameters and lengths. Order it in uniform gage or with thickened centers or ends. Factory fabrication eliminates handling and equipment costs for on-site bending and means less wastage, according to maker. Tube is crated and shipped on a disposable pallet to insure parallel leg alignment.—Chase Brass & Copper Company

176 **Calcium-silicate pipe insulation** and aluminum jacket come in a single package, with installation time, carton to pipe, cut to 90 seconds. Package is made up of .016-in. aluminum integrally combined with a vapor barrier and permanently attached to insulation material. It's designed for temperatures to 1200 F and can be cut to size right on the job with a power or hand saw.—Johns-Manville

177 **Prefab piping systems** are designed for underground or overhead distribution of steam, hot water, oil, process liquids, refrigeration. Complete system is shipped direct to job site.—Portage Insulated Pipe Company

178 **Tough steel jacket rings** are made in 90-deg segments. You can spot-weld them around stack or other hot non-insulated piping during or after construction to hold jacketing away from hot surface so it remains cool. Rings come in any diameter with attached jacketing.—Preformed Metal Products Company, Inc

179 **Extruded niobium** is now in commercial production, available in ¼- to 1-in. dia rod, ½ to 1-in. OD tube in lengths up to 20 ft or special sizes to order. High-temperature strength makes niobium a valuable atomic-plant material, maker states.—Calumet & Hecla, Inc, Wolverine Tube Div

180 **Cellular-glass insulation** is offered in temperature range of 35 to 350 F. Low-cost rigid insulation comes in 24-in. lengths in nominal thicknesses of 1 and 1½ in. for steel pipe or copper tubing from ½- to 6-in. dia.—Pittsburgh Corning Corporation

181 **Pipe hanger** offers constant load-supporting capacity for piping systems subject to expansion and contraction due to temperature change. Spring-actuated counter-balances produce constant support for loads traveling vertically, according to the manufacturer.—Fee & Mason Manufacturing Company

182 **Acetal-resin pipe plugs** seal against pressures as high as 10,000 psi. Hollowed-out centers increase threads' sealing ability as pressure is applied. Units are resistant to corrosion, inert to all solvents.—E I Du Pont de Nemours & Company

183 **Uniform, solid cone** is produced by general-purpose spray nozzle. Unit is said to discharge large quantities of liquids at low pressures in medium to coarse sprays with normal angle of 70 deg—a distribution pattern specially good for scrubbing fumes, cooling gases, gas-washing operations.—Schutte and Koerting Co

184 **New expansion joint** and new steam-line construction method work together to eliminate concrete conduit and manholes in most installations. Expansion joint can be covered to protect bellows from loose insulating material. Then just pack line with granular poured-in-place hydrocarbon insulation which cures as line is heated.—Badger Manufacturing Company

185 **Noncritical fittings** are made lighter to save you money. Designed for nominal-temperature low-pressure process piping, they're stocked in ½-to 4-in. sizes in stainless-steel grades best suited to corrosive applications at 150 psi and less. Returns, reducers, tees and crosses are available. A carbon-steel swivel type insert flange has stainless-steel insert at bore into which you expand pipe or fitting. Just rotate it to line up bolt holes, then tighten—no welding needed, maker reports.—Chemetron Corporation, Tube Turns Div

186 **Universal expansion joints** accommodate pipe movement in any direction. Bellows type joints are packless, corrugated. They come in standard sizes from 3- to 72-in. dia, pressures to 2500 psi.—Zallea Brothers

187 **Exotic-liquid filters** are used with hydrogen peroxide, hydrazine, ethylene oxide and LOX. In case of clogging, the furnace-welded wire-mesh filter medium can withstand full system pressure without collapsing, maker reports.—Pall Corp, Micro Metallic Div

188 **Copper sweat-fitting expansion joints** are recommended for hot-water heating and refrigeration applications from −30 to +240 F. They have 2-in. axial expansion. 360-deg rotation.—Rotherm Engineering Company, Inc

189 **Bellows expansion joints** are used for district-heating and other hot-water and steam lines. They'll absorb thermal expansion and contraction in applications up to 275 psi, 750 F, are also used to avert excessive stresses due to vibration or misalignment.—Chemetron Corporation. Tube Turns Div

190 **Pressure snubbers** protect pressure-sensitive instruments against line-induced pulsations or surges in refrigeration or air-conditioning systems. An added bonus: design eliminates a joint to deter refrigeration-system leaks.—Chemiquip Company

191 **Revolving sealing connection** joins stationary supply pipe to revolving machine cylinder, roll or drum. The union handles steam, water, air, vacuum up to 250 psi or 150-psi steam.—Perfecting Service Company

192 **Extreme chemical resistance,** low coefficient of friction, good thermal characteristics and resistance to extrusion, low compression set make this silicone O-ring your choice for varied service conditions. Even at temperatures of 300 F linear expansion will be no more than 0.01 in. per in., reports the manufacturer. Unit has a good "memory" at temperatures below 30 and above 200 F.—Fluoro-Plastics, Inc

193 **Single-basket pipeline strainers** feature minimum flow resistance, simplicity, quick cleaning and economy. They're available in sizes from two to six in., rated 125 psig (cold).—Schutte and Koerting Company

194 **Metal-to-metal seal** handles critical and varying degrees of pressure, flow and temperature. Assembly is applicable to all types of valves, has tested successfully as a pilot-operated shutoff valve with 10,000-psi nitrogen.—Hydraulic Mechanisms, Inc

195 **Giant expansion joint** measures 21x28 ft. It's designed for condenser service, to take external pressure of 14.7 psig, internal pressure of 15 psig. It will accommodate 9/16-in. compressed travel, ¼-in. expanded travel at maximum temperature of 500 F.—Temp Flex Company

196 **Pipe unions stand up** to service at extreme pressures of 2000 to 6000 psi, or under corrosive conditions. They come with threaded or socket-weld ends and they're made of Carpenter 304 or 316 stainless steel. A Teflon seal is wholly confined.—The Special Screw Products Company

197 **Laminated-fiber disk filters** are rated up to 3000 psi. Available in five sizes, from 1.5 gpm, 3-psi pressure drop to 47.6 gpm, 6-psi pressure drop filtering 100-ssu-viscosity mineral oil, they comply with ASME Code requirements.—Wm W Nugent & Co, Inc

198 **Drip feeding** under high pressure, corrosive duty, temperatures from below zero to +750 F are tackled by this sight feeder. Unit is rated 2000 psi at 100 F, 1100 psi at 750 F.—Jerguson Gage & Valve Co

199 **Gasketless orifice union** has cup-shaped stainless-steel orifice plate. Plate fits between conventional pipe-union head and tail pieces to form leakproof seal—unions come in ⅛- to 2-in. pipe sizes with 3000-psi rating.—Catawissa Valve & Fitting Co

200 **Pipe and block insulation** made of expanded silica takes temperatures up to 1600 F in its stride. Other features are water resistance, light weight combined with strength, easy cutting.—The Philip Carey Mfg Company

201 **Steam-sampling nozzles** take accurate line samples of steam for analysis. Ports are positioned so sampling is proportionate to entire steam-line cross section.—Trinity Equipment Corporation

202 **High-pressure filter** provides effective filtration for lube oil, hydraulic fluids, air and gases at pressures to 1000 psi, temperatures to 275 F. Use replaceable paper elements, wire-mesh or metal-edged filtering media.—Purolator Products, Inc

203 **Inflatable thinwall metal tubing** will be shipped in ribbon form, inflated at point of use. Shipping should be more economical—you ship the walls and not the hole. This tubing may simplify problem of sheathing power distribution and communications cable. Experimental production will begin this fall.—Wolverine Tube Company, Calumet & Helca Div

Up-to-date design aids: To get your copies, circle key numbers on convenient Reader Service card, p 227

VALVES

540 **All-molded PVC valves** for corrosion resistance are covered in 6-p folder 601. Lunkenheimer Co

541 **Oil, water or air-service** valves, manual, foot-operated and solenoid, are described in 20-p catalog 59-60. Barksdale Valves

542 **Stainless-steel valves,** steel-gate, globe and swing-check types, are topic of catalog 59 SS—10-p section shows resistance of various alloys. Jenkins Bros

543 **Cast-steel valves**—gate, globe, angle, swing check—are covered in 20-p booklet KS-1. Includes photos, diamensions, ratings. Kerotest Manufacturing Co

544 **Surge-relief valve** to protect water lines against overpressures is subject of 8-p bulletin W-2-A. Includes detailed drawings, suggested specs. Golden Anderson Valve Specialty Co

545 **General-service** valves are discussed in 20-p bulletin E-165. Covers types, applications, construction, features. Everlasting Valve Company

546 **Tandem blowoff valves** for pressures to 665 psi are topic of 4-p book B-435. Yarnall-Waring Co

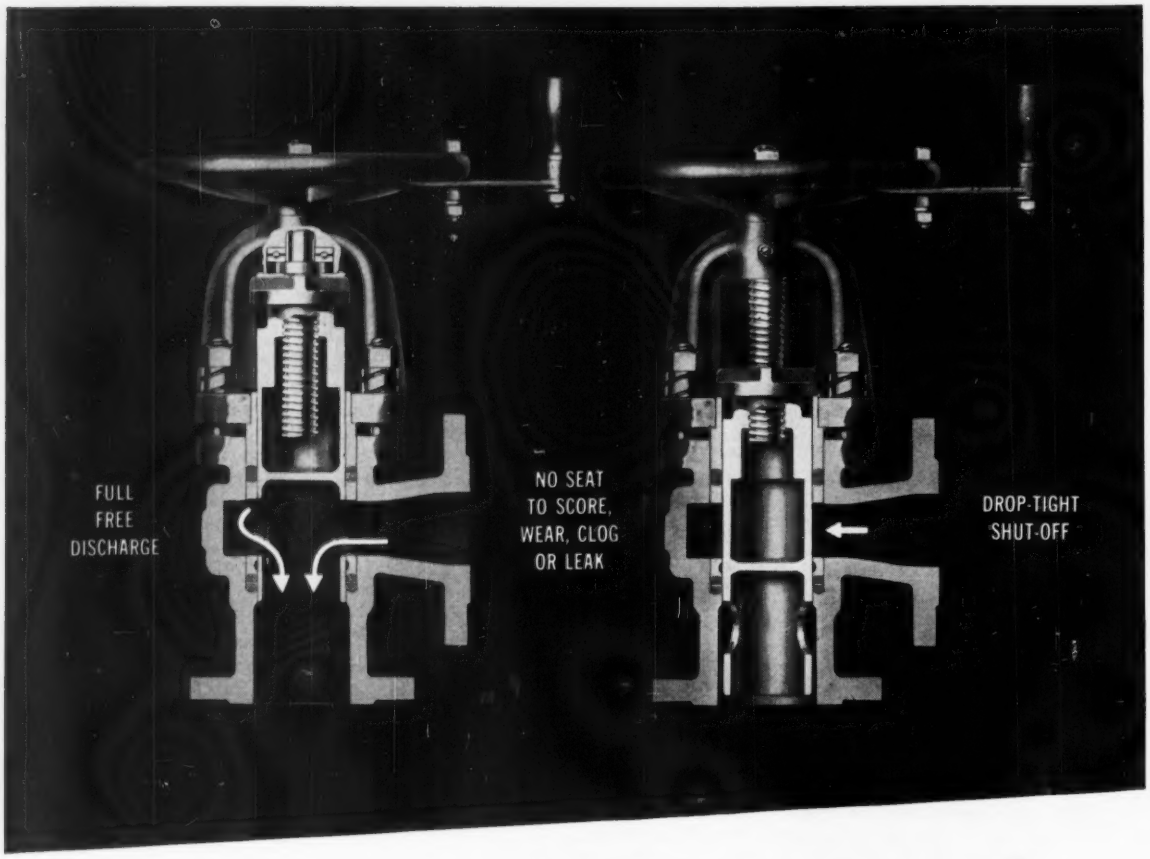
547 **Refrigeration valves,** fittings and supplies are listed in 32-p catalog. Tables on refrigerants, brines, pipe and tubes make up an 8-p section. Frick Company

548 **Teflon-seat and disk** valves are illustrated in bulletin 11. Alloy Steel Products Company, Inc

549 **Bronze, globe, angle,** check, gate valves are listed in 12-p catalog. Includes pressure ratings, uses, features for a wide size range. Ohio Brass Company

550 **Bypass 3-way valves** for feedwater heaters are covered in 4-p bulletin 8F. Schutte and Koerting Company

continued



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For more facts circle 923 on Reader Service card, p 227

551 **Nonreturn valve** to protect boiler is topic of 8-p bulletin S-2-B. Drawings, diagrams illustrate single-acting unit. Golden-Anderson Valve Specialty Company

552 **Tilting-disk check valve** is detailed in 16-p bulletin. Gives features, specs, data for cast-iron and steel units. Dominion Engineering Company Ltd

553 **Pressure-reducing valve** for steam, water, oil, gas, air, chemicals is topic of 6-p folder J-160. OPW-Jordan

554 **Safety relief valves** are detailed in 88-p catalog 88. Valves from ½ to 6 in., made of bronze, semisteel or steel are described and illustrated. Includes extensive engineering charts and data. Marine & Industrial Products Co

555 **Gate valves** designed for ductile iron are subject of comprehensive 8-p brochure 1010. The Ohio Injector Company

556 **Butterfly valves** are described in 8-p bulletin 583. Table gives pressure drop for seven classes. W S Rockwell Company

557 **Cryogenic-handling** valves are featured in 12-p catalog C-591. Also lists strainers, filters, accumulators, other products. Koehler Aircraft Products Co

PIPING, FITTINGS and SPECIALTIES

558 **Medium-pressure** hydraulic-hose and tube assemblies are listed in 36-p bulletin 109. Includes dimensional drawings and tables of available sizes. Eastman Mfg Co

559 **Glass-fiber pipe insulation** for subfreezing to 350-F temperature range is subject of informative 8-p folder WPN-2. L O F Glass Fibers Company

560 **Gas manifolds** are discussed in 24-p catalog 829. Details capacities, dimensions and arrangements. Air Reduction Sales Co

561 **Welded carbon** and stainless-steel tubing is topic of 12-p brochure. Covers size ranges, applications, welding. The Formed Steel Tube Institute

562 **Supercritical power piping** for Eddystone's 5000-psi 1200-F unit is topic of 12-p brochure. Tells piping story from selection to erection. The M W Kellogg Company, Fabricated Products Div

563 **Pipe and block insulation** of expanded silica is topic of 4-p sheet. The Philip Carey Mfg Company, Industrial Insulation Div

564 **Manifold systems** for continuous distribution of industrial gases are discussed in 28-p brochure N-125. Includes systems for oxygen, hydrogen, helium, argon, acetylene. Chemetron Corporation, National Cylinder Gas Div

565 **Pipe and equipment insulation** effective for temperatures to 1800 F is covered in 8-p brochure 1-IN-759. Owens-Corning Fiberglas Corporation

566 **Stainless-steel pipe fittings** are covered in 86-p master reference. Technical section includes manufacturing standards, specs, welding info, corrosion-resistance tables. Ladish Co

567 **Conduit pipe fittings** of rigid aluminum are detailed in 8-p catalog 205. Conduit Nipple Manufacturing Company

568 **Connectors** for flexible metal hose are illustrated, described and priced in complete 16-p catalog 658. D K Manufacturing Co, Cobra Metal Hose Div

569 **Hose fittings** for air, spray, welding are covered in 4-p bulletin 198. Hose Accessories Company

570 **Quick-coupling assemblies** in bronze, aluminum, monel, stainless steel and semisteel are described in 8-p catalog F-10-R. OPW-Jordan

571 **Steam specialties**—valves, thermostatic traps, steam traps—are featured in 12-p bulletin 203. American Air Filter Co, Inc

572 **Pressure plugs** to seat flush in hydraulic, pneumatic and other h-p systems are covered in 4-p bulletin 2501. Standard Pressed Steel Co

573 **Industrial O-rings,** other seals are topic of 24-p fact book. Includes specs, size charts, installation guides. Minnesota Rubber Co

574 **Spray nozzles** for small to medium quantities are discussed in 20-p booklet AD-148, bulletin 6A-622-2. Photos show distribution patterns delivered by four styles. Schutte and Koerting Company

575 **O-ring design** and application is discussed in 20-p booklet AD-148. Covers materials, dynamic and static applications, groove design of the units. The Garlock Packing Company

576 **Self-cleaning strainers,** automatic and twin-basket models, are covered in 17-p catalog. Units remove and dispose of fine suspended particles in raw or process water, other liquids. S P Kinney Engineers, Inc

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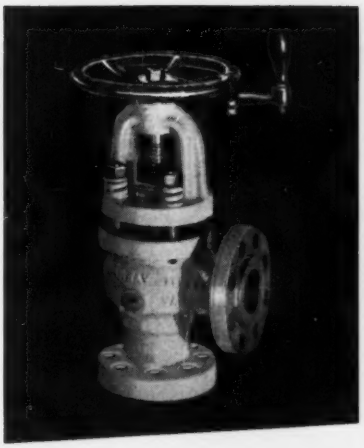

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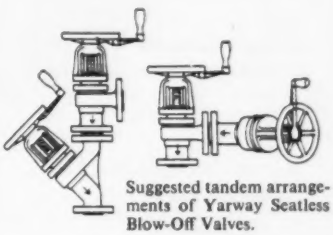

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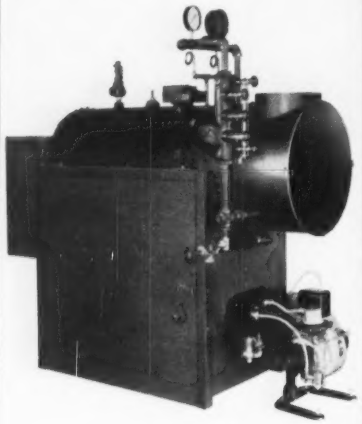

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Piping and fittings

Begins on page 281

577 **Universal steam traps** are detailed in 16-p bulletin 800. Includes capacity charts and a steam-pipe selection nomograph. Perfecting Service Company

578 **Y, basket strainers** for all services are listed in new catalog. The Mueller Steam Specialty Company

579 **Expansion joints** and flexible couplings of rubber, neoprene, Teflon-lined rubber are subject of 8-p bulletin FJ-1058. The Belmont Packing & Rubber Co

580 **Swing joints,** available with synthetic rubber O-rings, are covered in 12-p catalog F-8. OPW-Jordan

581 **Forged-steel unions** are detailed in 8-p catalog U-2-58. H K Porter Company, Inc, Forge and Fittings Div

582 **Compression type packings** are discussed in 24-p catalog. Photos, drawings illustrate constructions available for various services. E F Houghton & Co

583 **Mechanical seals** for all centrifugal pumps are listed in 4-p bulletin. Borg-Warner Corporation

584 **Hydraulic packings,** homogeneous and fabric-reinforced types, are detailed in 16-p bulletin P-333. Crane Packing Company

585 **All - purpose rotary union** is studied in 16-p bulletin 700. Installation drawings, cutaways, exploded views give details. Perfecting Service Company

586 **Convoluted and unispaned** expansion joints are topic of 24-p brochure 60. Gives detailed info on size and weight plus expansion and contraction data. Associated Piping & Eng Company, Inc, Temp Flex Div

587 **Pneumatic products** are subject of 20-p catalog. Gives specs, engineering and operational data, performance characteristics for air-line filters, regulators and lubricators. Watts Regulator Company, Industrial Div

588 **Metal packings** for pumps, engines and compressors are subject of 24-p booklet AD-166. Includes selection, application and installation data. The Garlock Packing Company

589 **Block insulation** is detailed in 8-p brochure. Amosite asbestos-base block insulation can withstand up to 1850 F. Aber Company, Inc

590 **Industrial insulation** handbook has 16 pp, describes fundamentals for the buyer, foreman or maintenance superintendent. Aber Company, Inc

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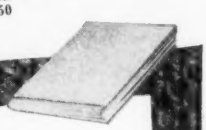

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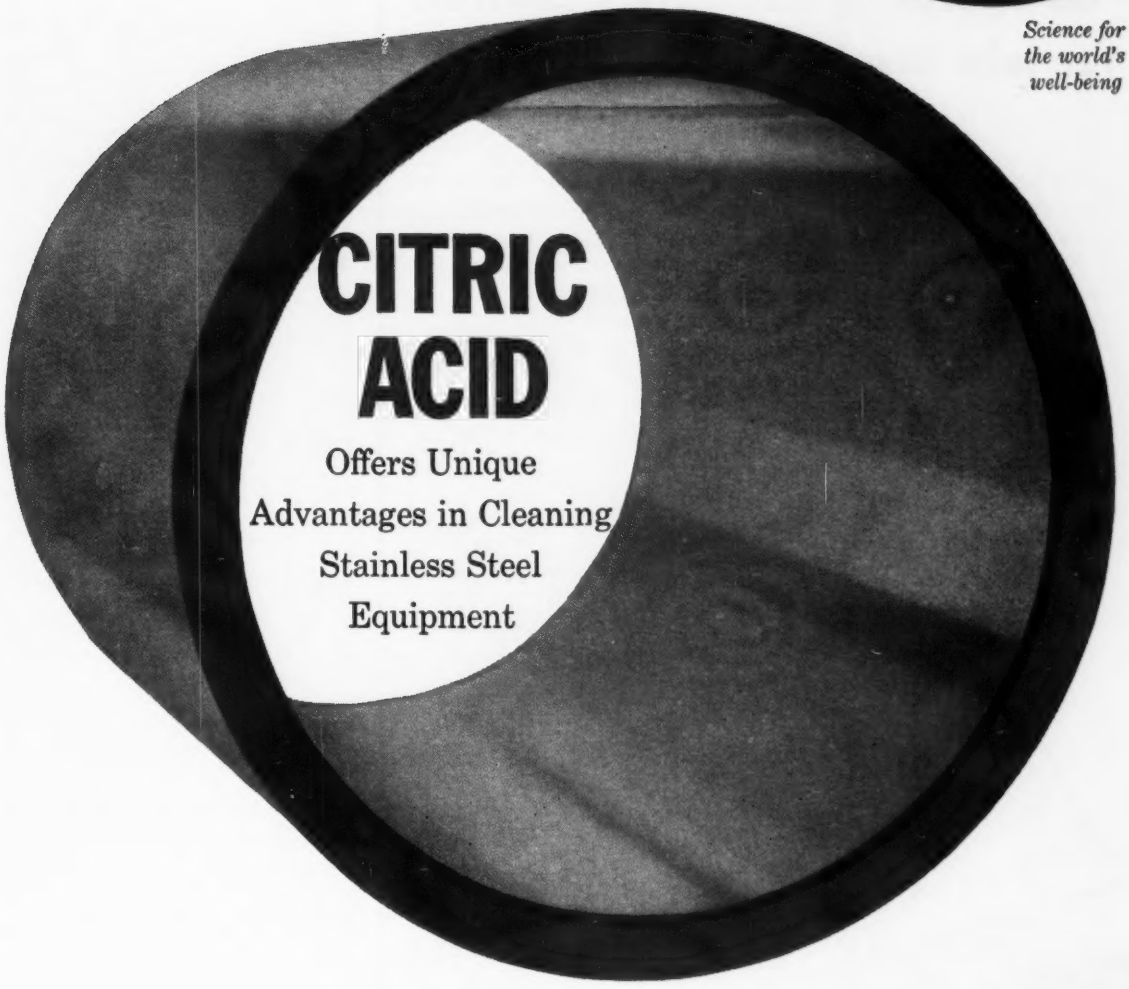

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For more facts circle 927 on Reader Service card, p 227

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Piping and fittings

Begins on page 281

591 **Tubings,** extruded and coated, are detailed in 24-p manual 59T. Gives complete specs, footage needs for cut pieces. William Brand & Co, Inc

592 **"Tubemanship"** is discussed in 16-p brochure. Describes skills and techniques involved in making seamless copper and copper-alloy tubing. Calumet & Hecla, Inc, Wolverine Tube Div

593 **Flexible metal hose** for diesels is featured in 4-p data sheet 10-X-552. Allied Metal Hose Company

594 **Stainless-steel tubing,** welding fittings and flanges are topic of 8-p bulletin TDC-190. The Babcock & Wilcox Company

595 **Carbon, alloy** and stainless-steel tubing, piping, fittings and flanges are listed in 4-p cross-reference folder TDC-186. The Babcock & Wilcox Company, Tubular Products Div

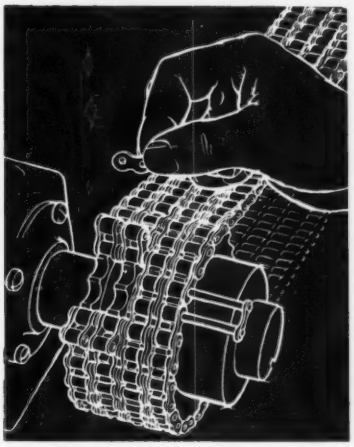
596 **Ductile iron products**—pipe, tubing, casing, fittings—are shown in 36-p catalog. Lists grades, dimensions and weights, applications. American Cast Iron Pipe Company

597 **Teflon hose** is subject of 6-p folder 400. Gives assembly, attachment specs. Titeflex, Inc

598 **Insulation for gas lines** and vessels is discussed in 6-p bulletin 5M-P-1-59. Baldwin-Hill Co, Insidline Div

599 **Beryllium-copper tubing** is topic of 6-p data memorandum 7. Superior Tube Co

MECHANICAL POWER TRANSMISSION



New materials, production techniques are proving their worth in the field. V-belt drives with markedly increased ratings have resulted from two different approaches. One combines new belt materials with sheaves of high-strength castings. Other takes advantage of an improved process to provide better belts. Both claim less belt and sheave per hp rating, less space and lower cost. Plastics have also been tried successfully for both flat transmission and conveyor belting.

Bearings and inserts of synthetics are getting more and more attention. Applications are still in the small size range, but these materials are worth watching.

D. W. Follansbee

Assistant Editor

MECHANICAL POWER TRANSMISSION: For further data on these developments, circle numbers on Reader Service card, p 277

204 **Shaft - mounted** variable - speed drive is compact, provides controlled speed in a lightweight space-saving power drive. All intermediate transmission elements are eliminated. Dripproof or totally enclosed constructions come in ¼ to 3 hp sizes, with speeds from 360 to 5.2 rpm, variations from 2:1 to 10:1.—Sterling Electric Motors, Inc

205 **V-belt drives** have smaller, lighter sheaves, belts with higher capacity at lower cost. The drives come in two standard groove sizes,

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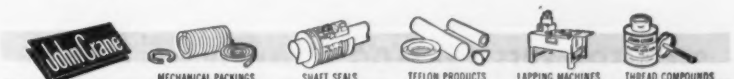

For more facts circle 929 on Reader Service card, p 227

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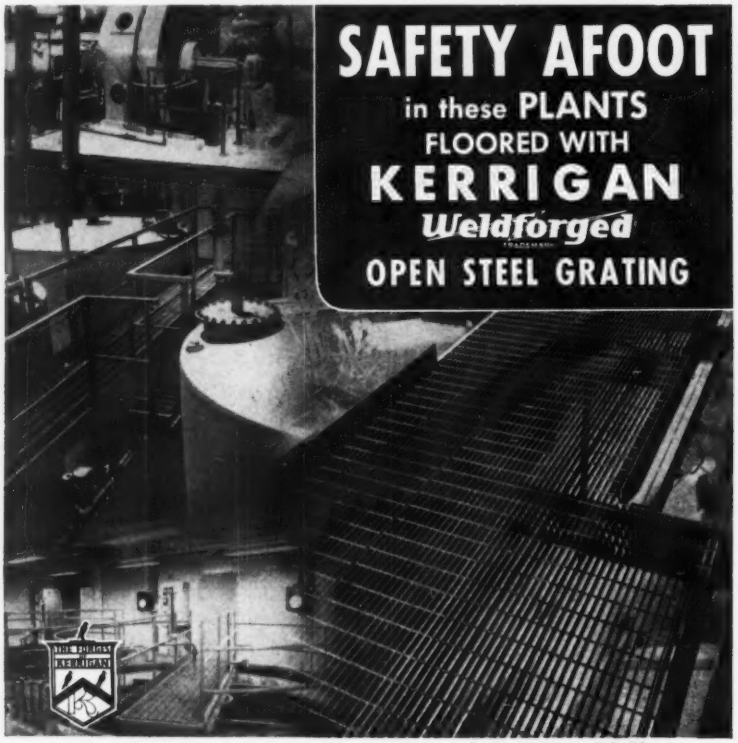

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Mechanical transmission

Begins on page 289

3/8 and 5/8 in. wide, to handle service up to 2000 hp. You can order custom-made sheaves and 1-in. belts for 1500 hp. Belts have crowned top and concave sidewalls for best efficiency. They resist oil and heat, conduct static. —Dodge Manufacturing Corp

206 **Oriented nylon strip** is laminated with leather or rubber providing strength and flexibility for power-transmission and conveyor belts. Strip, now first manufactured in U.S., is oriented by changing direction of molecular structure. It comes in thicknesses up to 1/8 in., widths to 3 in.—Reeves Brothers, Inc

207 **New type of V-belt** has 40% hp-rating increase over firm's previous best. Cords of each belt are normalized, impregnated with latex. Molding process increases wear resistance by converting covers to a homogeneous blend.—United States Rubber Company

208 **Standard gearmotors** and reducers are now produced in 200-hp ratings, reported to be industry's largest standard drive units. Gearing efficiencies are 94 to 97%, depending on number of reductions —double, triple and quadruple reductions come in AGMA ratios up to 440:1. Carburized and hardened final-stage helical gearing, precision-ground teeth are long-life features. Large-diameter shafting and oversize bearings handle severe overhung loads and shock conditions without a murmer. Most standard NEMA "D" flanged and foot-mounted ac motors come direct from stock; special features can be ordered.—Philadelphia Gear Corporation

209 **Heart** of a new magnetic clutch is angular-split air gap that converts part of thrust load to bear against radial bearing. Unit lets you use smaller machine transmissions because it produces more torque for its size. A stationary magnetic field does away with slip rings and brushes—these units practically eliminate maintenance. Five sizes have torque ratings from 14 to 290 lb per ft.—I-T-E Circuit Breaker Company

210 **Cost reductions up to 20%** are promised by new V-belt drives. Narrower, deeper-cross-sectioned,

For more facts circle 931 on Reader Service card, p 227

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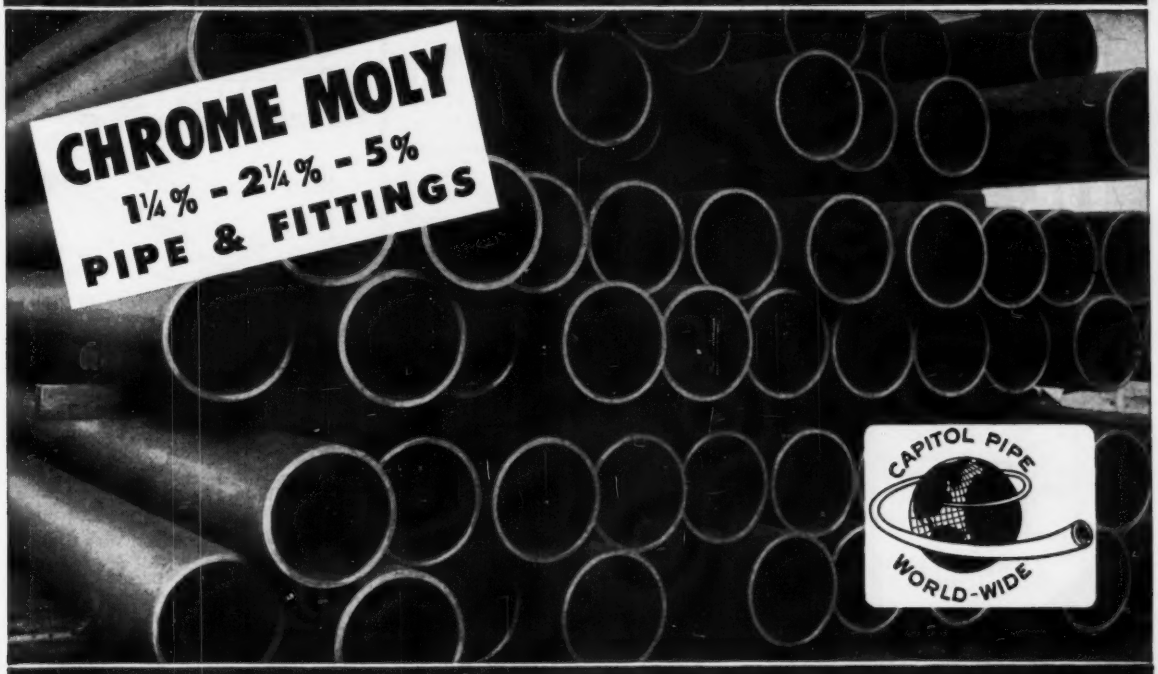

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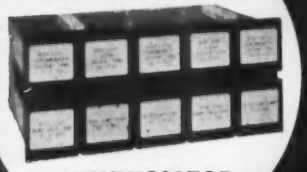
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Mechanical transmission

Begins on page 289

higher-capacity belt and sheaves, reduced diameters add up to major space and weight savings over conventional models. Arched top of belt prevents distortion of tensile section while concave sidewalls eliminate concentrated wear on sides, insure precision fit in groove for best pulling power. Your drive requirements are completely covered with three cross sections instead of five for bonus inventory savings, the manufacturer reports.—The Gates Rubber Company

211 **Packaged electric clutch** and sheave are directly installed on all standard NEMA electric-motor shafts. Five sizes, rated 1 to 25 hp, apply to new or existing plant equipment. Factory-aligned and assembled units feature no-load starting—they engage or release at any speed, and for inching or jogging, you can make several starts in less than one revolution of the clutch. On installations where motor is started and stopped often, elimination of high motor-starting currents means smaller starters can be used.—Warner Electric Brake & Clutch Co

212 **Totally enclosed** fan-cooled brake-motor with all-aluminum-alloy construction has ratings from 1 to 30 hp at frame sizes of 182 through 326 U. Motor acts as magnetic brake and cooling fan—doughnut-shaped magnet allows motor shaft to extend entirely through unit. Drive motors can be squirrel cage, wound rotor or fluid shaft.—Reuland Electric Company

213 **Precision bearing cartridge** mounts permanently in strong, lightweight 1-piece malleable housing. Housing design permits flush or recessed mounting for flexibility, desired shaft extension with minimum overhang. The 2- and 3-bolt flange units come in sizes from ¾ to 1 7/16 in.—Stephens-Adamson Mfg Co, Sealmaster Bearing Div

214 **Spherical roller bearings** feature large convex rollers, precision-machined and centrifugally-cast bronze retainers and high, heavy inner race shoulders. All components are reported to be in optimum balance for long maintenance-free performance. Units

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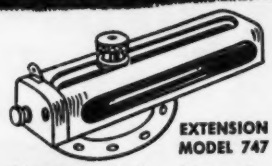
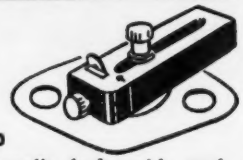

EXTENSION MODEL 747
Aluminum body with steel blades and inch and metric scales. Cuts precision round gaskets any size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Phenolic body with steel blades and inch and metric scales . . . cuts round gaskets ¼" to 6", odd shapes and straight pieces any size

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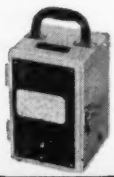

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circle 935 on Reader Service card, p 227

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You can control hot water temperatures automatically–economically

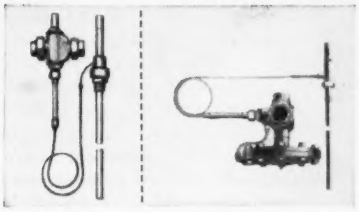
By John W. Ritter, Test Engineer
SARCO Company, Inc.

A dependable supply of hot water at exactly the right temperature for employee comfort is just as important a task for the plant engineer as providing properly heated water for process requirements. Fortunately, accurate, reliable regulation of water temperature is easy to achieve *economically* through the use of properly selected temperature controls.

It's impossible to maintain constant supervision of the delivered temperature of hot water with manual controls. Accommodating fluctuating loads that vary all the way from zero to peak requires automatic temperature regulation, controls that stay on the job all day long.

What to look for:

Automatic regulators are not difficult to select if you bear in mind the degree of control you require. You need reliability within a fairly constant predetermined temperature range — anything more than the *simplest mechanism to do this job is a waste of money.*

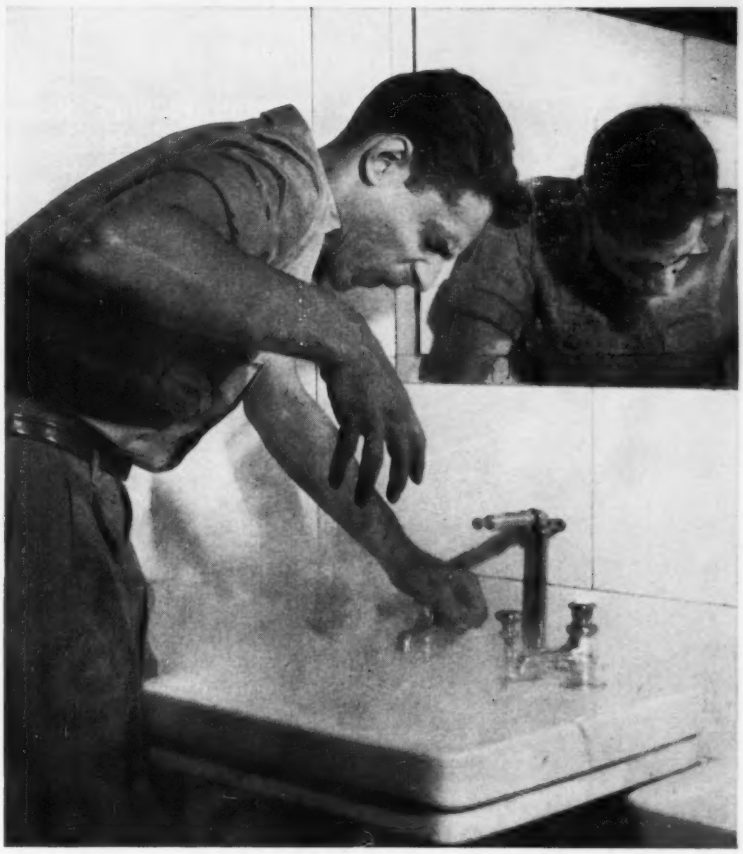


Sarco Type 50-21 Self-Powered Temperature Regulator

Sarco Type 24-30 Self-Powered Pilot Operated Temperature Regulator

First cost is important, naturally; but it is also well to examine very carefully the cost of installing or maintaining a temperature regulator. A pipe fitter should be able to do the job. When all these criteria are applied to regulator selection, the logical choice narrows to a self-operated type like the Sarco 24-30 pilot-operated model or the fully-modulating 50-21. Both of these regulators operate by powerful self-contained hydraulic systems that provide smooth operation with even increments over their full temperature range.

Both Sarco self-operated types give you automatic temperature control without high cost. The result: hot water constantly supplied at the required temperature regardless of fluctuations in supply or demand.



End erratic hot water temperature... with SARCO Self-Powered Controllers

You'll find Sarco Self-Powered Temperature Controllers regulating water temperature in scores of industries. And because these Sarco Temperature Regulators require no electricity, compressed air, or any external power supply, because they're the simplest automatic controls made, they can be kept in first-class working order by the regular maintenance staff — without special training. There are no glands or stuffing boxes, nothing to get out of order. And Sarco Regulators are inexpensive to buy, easy to install.

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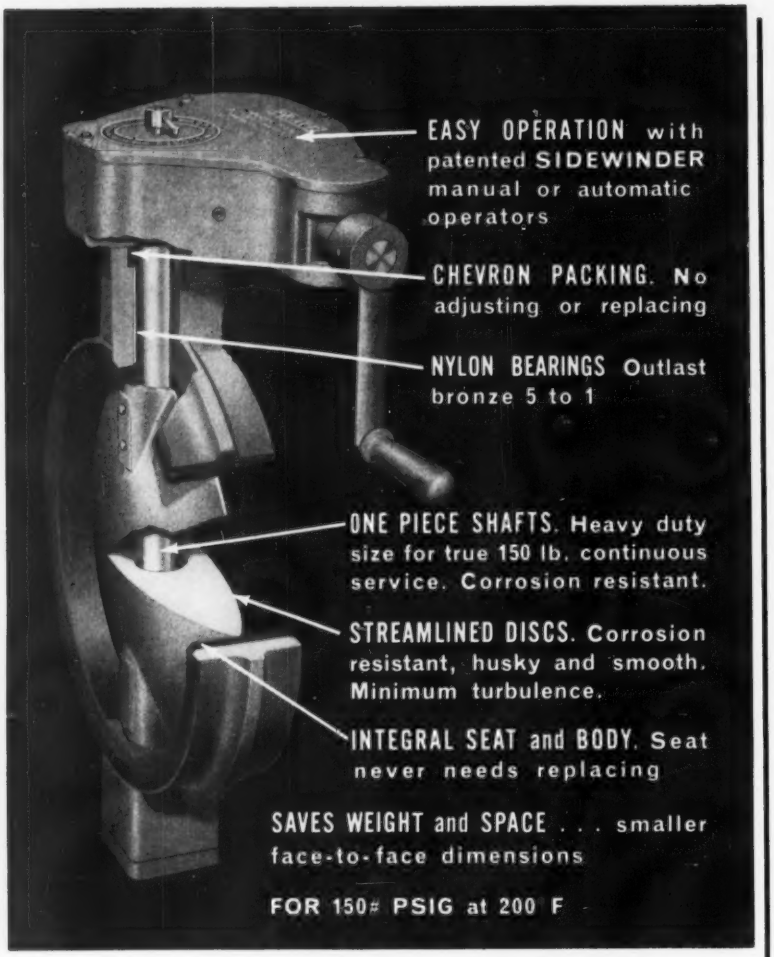
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Mechanical transmission

Begins on page 289

come in bore sizes from 1.5748 to 11.0236 in. with dynamic load ratings to 288,000 lb. Later pillow-block models will be made in bore sizes from 1 7/16 to 10 in.—Link-Belt Company

215 **Flexible couplings** are used in direct-driven machinery where torque isn't excessive in relation to shaft diameter. Four studs and sleeve bearings provide positive, resilient drive with no lube needed. Cast semisteel flanges are accurately machined.—Ajax Flexible Coupling Co, Inc

216 **Sound-conditioned** pillow-block ball bearings promise extremely quiet operation. Synthetic-rubber cushion between outer ring and lightweight pillow-block housing insulates against vibration, suppresses noise. Bearings come in five shaft sizes, ½ through 1 in. —Hoover Ball and Bearing Co

217 **Confined-space coupling** makes it easier to join pipe and tubing where space is limited or where you want remote-control operation. One application permits access into control-rod standpipes of a nuclear-power reactor. Unit consists of a conventional coupling with gear and pinion locking mechanism added. Patented by Geartight Unions, Ltd of England, device is manufactured by—Stanat Manufacturing Co, Inc

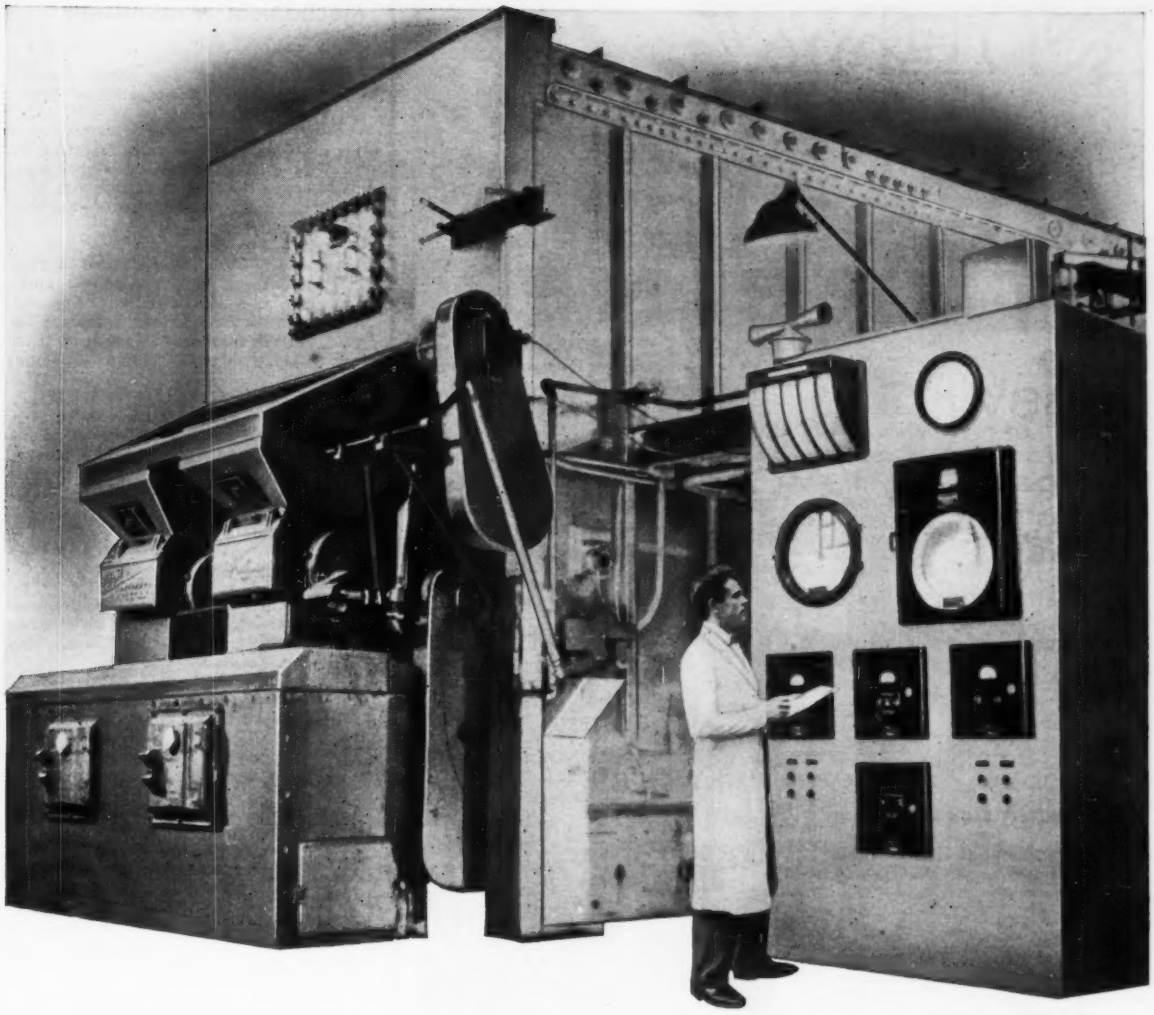
218 **Chain bushings** have built-in lube to prevent faulty-lube headaches. In the critical areas of pin, plates and sprocket engagement, oil impregnation minimizes wear by providing an oil cushion reducing metal-to-metal contact.—Whitney Chain Company

219 **Variable-speed transmission** is built around a new timing V-belt, provides 3:1 ratio with basically constant hp. Segment of worm gear is mounted to idler-carrying side plate for speed adjustment. Rated capacity is 1.5 hp with input speed of 1750 rpm. Operate it in any position.—Western Manufacturing Company

MECHANICAL TRANSMISSION DESIGN AIDS: Circle key numbers on p 227

600 **Shaft-mounted** speed reducers are listed in 10-p engineering manual B-7238. Selection, hp ratings, dimensions, installation and

For more facts circle 937 on Reader Service card, p 227



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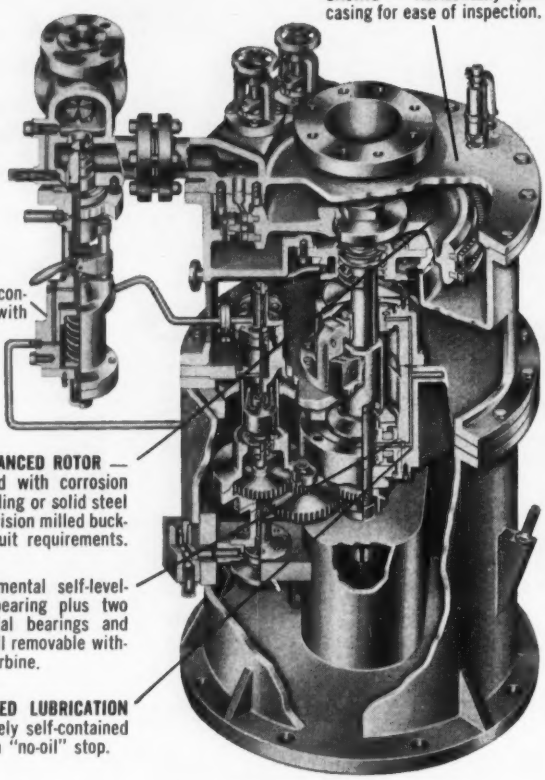
NEW Whiton VERTICAL TURBINE

Type BHBSV for Vertical Pump Drives


CASING — Horizontally split casing for ease of inspection.
SPEED CONTROL — Oil constant speed governor with overspeed stop.
DYNAMICALLY BALANCED ROTOR — Either steel forged with corrosion resistant steel blading or solid steel one piece with precision milled buckets available to suit requirements.
BEARINGS — Segmental self-leveling type thrust bearing plus two babbitt lined radial bearings and shaft packing — all removable without dismantling turbine.
FORCED FEED LUBRICATION — Completely self-contained system with "no-oil" stop.

The Whiton Vertical Turbine is extremely versatile, compact and dependable . . . ideal for vertical pump drives and other similar applications. The vertical design requires minimum installation space and allows great freedom of location. Simplicity of design and construction results in ease of operation and servicing.

With this vertical turbine added to the line, Whiton's vertical and horizontal steam turbines offer a broad range of power supply applications. Complete data on the new vertical turbine and others available on request.

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POWER	to 1000 HP
SPEED	to 8500 RPM
STEAM PRESSURE	to 1250 PSIG
STEAM TEMPERATURE	to 1050° FTT

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Mechanical transmission

maintenance are some factors discussed. Westinghouse Electric Corporation

601 **Worm-gear sets** are detailed in 24-p catalog. Provides drawings, selection data and basic information. De Laval Steam Turbine Company

602 **Gearmotors** are discussed in 32-p booklet J-17. Gives info on horizontal- and vertical-mounted units with capacity up to 125 hp and output speeds ranging from 780 to 1.2 rpm. Hewitt Robbins, Inc

603 **Takeup units** are featured in 16-p bearing catalog BU-101-B. Covers pillow blocks, flange blocks, ball bearings. Browning Manufacturing Company

604 **Adjustable-speed drive** in ¾- to 7½-hp range is covered in 6-p bulletin 2750. The Louis Allis Co

605 **Motorized gear drives** are described in 4-p bulletin 2350. Gives cutaway, diagrams, specs. The Louis Allis Co

606 **Power-transmission machinery**—fluid drives, couplings, V-belt drives—is reviewed in 8-p bulletin A-706. Dodge Manufacturing Corporation

607 **Right-angle gearmotors** are topic of 4-p bulletin 3050. Units are rated 1/3 to 30 hp, single reduction, with speeds of 23 to 280 rpm. The Louis Allis Co

608 **Helical gearmotors** and speed reducers are described in 16-p bulletin GEA - 6704. Cutaways show easy-maintenance features. General Electric Company

609 **All-steel motor reducers** are topic of revised 28-p bulletin 3100. Helical-gear all-motor and integral units use NEMA motors from 1 to 75 hp, maker states. The Falk Corporation

610 **Gearmotors and fluid drives** are detailed in 48-p book 2747. Lists selection data, dimensions, overhung load ratings and mountings. Link-Belt Company

611 **Speed reducers** in sizes up to 40 hp are covered in illustrated 4-p bulletin 20B9053. Allis-Chalmers Manufacturing Company

612 **Timing belt drive** available in five belt pitches is covered in 4-p bulletin 20B8760. Allis-Chalmers Manufacturing Company

613 **Sliding motor base** of welded steel is one subject of 12-p catalog V-183-B. Gives complete specs for other variable-pitch drives. Browning Mfg Company

614 **Longer life** from V-belt drives is topic of 12-p manual. Case histories, trouble-shooting guides help you pick proper belts to

Begins on page 289

suit your needs. B F Goodrich Industrial Products Company

615 **Variable-speed pulleys** designed to eliminate freezing and sticking are introduced in 12-p bulletin 4101. Gives technical data for five sheaves for ratings of 2, 3, 5, 10 and 15 hp. T B Wood's Sons Company

616 **New model V-belt drive** is subject of 32-p catalog DH-900. The Gates Rubber Company

617 **Replacement belts** for variable-speed units are described in 12-p catalog V-173-B. Browning Manufacturing Company

618 **Variable-speed pulleys** to eliminate freezing and sticking are covered in 12-p catalog 4101. T B Wood's Sons Company

619 **V-belt drives** claimed to be smaller, cheaper, lighter are covered in 44-p bulletin A-695. Dodge Manufacturing Corporation

620 **All-synthetic belting** for modern drives is described in 6-p folder. Advantages, hp ratings, correction factors are listed. J E Rhoads & Sons

621 **Variable-speed drives** for precise, adjustable output speeds from a constant-rpm motor source are covered in 8-p bulletin G-5812. Reeves Pulley Company

622 **Speed drives,** mechanical and adjustable 25-hp units, are introduced in 16-p illustrated bulletin GEA-6806. Lists mounting positions, ratings, available accessories. General Electric Company

623 **Adjustable-speed drives** are discussed in 8-p bulletin GEA-6234B. General Electric Company

624 **Variable-speed drive** bulletin 195 has 8 pp, features photos of drives and modifications, suggested variable-speed applications. Sterling Electric Motors, Inc

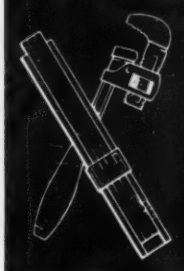
625 **Extra-light ball bearings** are outlined in 4-p bulletin 108. Tables give capacity, interchangeability data. Hoover Ball and Bearing Company

626 **Roller bearings** are discussed in catalog PL-559. Gives specs, features, sizes and application data. Rollway Bearing Company

627 **Flexible shafts,** clutches, gearboxes, tachometers are listed in 14-p catalog. Barbour Stockwell Instruments

628 **Fan-cooled worm gear** that mounts at any angle is topic of 4-p bulletin 5018. De Laval Steam Turbine Co

629 **Flexible gear coupling** with nylon sleeve is described in 4-p



YOU GET EVERYTHING THE ENGINEER & MAINTENANCE MAN ASKED FOR IN THIS NEW LIGHT WEIGHT, COMBINATION STEAM TRAP!

Fast warm up through rapid removal of both air and condensate up to 10° F. of saturation.

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Continued discharge of air and condensate at steam temperature.

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Built-in filtration of solids

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Easy access to all working parts

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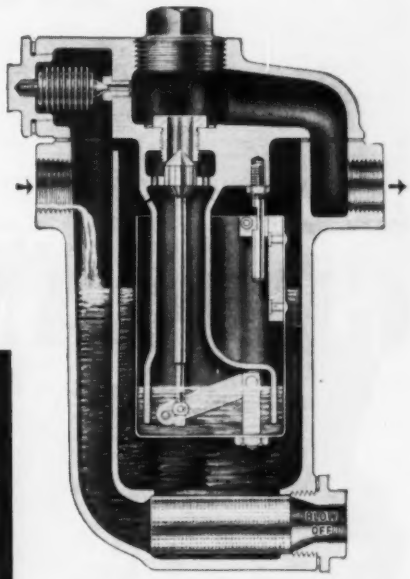
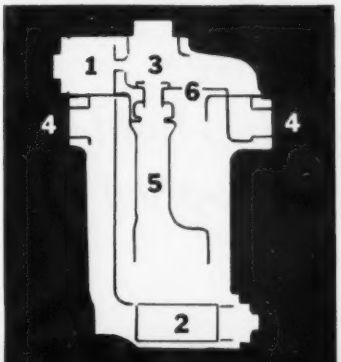
Step by step steam traps have been improved, making them compact, lighter and more efficient, easier and faster to service. Now Wright-Austin has incorporated all these advances into one of their proven vertical bucket-type traps—the new 500-C series. Write for literature.



500-C Series—For ½" to 2" pipe lines; Pressures to 150 PSIG; Capacity to 30,000 lbs./hr.



1. Monel thermostat air by-pass
2. Monel strainer
3. Valve seat accessible through inspection plug
4. Straight-through pipe connections
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For more facts circle 940 on Reader Service card, p 227

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Spark Free!
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To Any
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Kato's complete line of 50, 60 and 400 cycle revolving field AC Generators is now available in brushless design.
Especially desirable for operation in gaseous environments.

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For more facts circle 941 on Reader Service card, p 227

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Mechanical transmission

Begins on page 289

folder. Tabular data covers hp and speed ranges, bore sizes. Sier-Bath Gear & Pump Co, Inc

630 **Dry fluid drives** and couplings are described in 24-p catalog. Engineering drawings, installation photos show how units solve various drive problems. Dodge Mfg Corporation

631 **Clutch-pulley package** for direct installation on standard electric motors, 1 to 25 hp, is subject of comprehensive 10-p booklet WEB-P-52. Warner Electric Brake & Clutch Company

632 **Screw conveyor drive** complete with speed reducer, packing gland and drive shaft is topic of 16-p bulletin A667C. Dodge Manufacturing Corporation

633 **Nylon-core belting** is topic of 12-p booklet. Gives history, advantages of the flat transmission belting. L H Shingle Company

634 **Dc magnetic brakes** are detailed in 4-p bulletin 5000. Illustrates proper maintenance procedures. The Electric Controller & Mfg Co

635 **Sheaves, V belts,** flat-belt pulleys, pillow blocks, many more are included in 8-p bulletin 3010. T B Wood's Sons Company

636 **Coupling catalog** has 24 pp, lists specs, engineering info. Dominion Engineering Company Ltd

637 **Precision gears** from 1- to 200-in. dia are described in 24-p bulletin GEA-6430. Gear-testing devices, high-speed flexible couplings are also covered. General Electric Company

638 **Integral-shaft sheaves** are topic of 6-p folder 20B7897B. Units promise low-cost speed control in large machine drives, according to the maker. Allis-Chalmers Manufacturing Company

639 **Flexible couplings** in ten sizes are covered in 8-p bulletin 10100A. Includes photos, tables, diagrams. T B Wood's Sons Co

640 **Ball bearings** for heavy radial loads are discussed in 4-p bulletin 107. Hoover Ball and Bearing Company

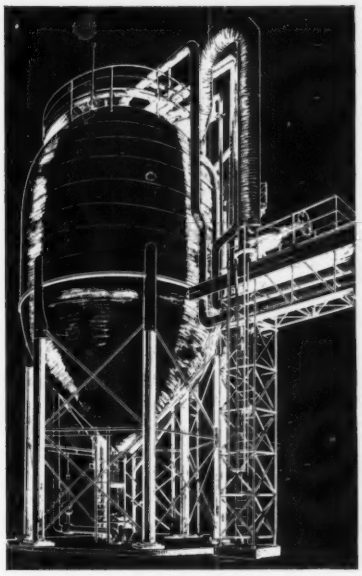
641 **Roller bearings** are featured in 48-p engineering reference manual M-59. Covers construction, dimensions, capacities, housing and tolerance fits. Orange Roller Bearing Company

642 **Deep-groove ball bearings** are featured in a 12-p bulletin, 110. Gives sizes, radial load and other application data. Hoover Ball and Bearing Company

643 **Coupling-selection guide** is feature of 12-p bulletin A669B. Dodge Manufacturing Company

For more facts circle 942 on Reader Service card, p 227

WATER TREATMENT



In the last 20 years, progress in water-treatment methods has truly been startling. Not too long ago, zeolite was just about the only ion-exchange method available. Today, however, a wide variety of methods have been developed to meet almost every industrial and power-plant need. And progress continues at an accelerated rate. Plant size reduction has come a long way and high-flow-rate demineralization promises even further progress in this direction with attendant lower costs. As convenient fresh-water sources become harder to find, need for sea-water distillation becomes more pressing. Interest in various methods is on the increase. Large capacities are involved and simplified unit operation is a goal.

V. W. Edwards

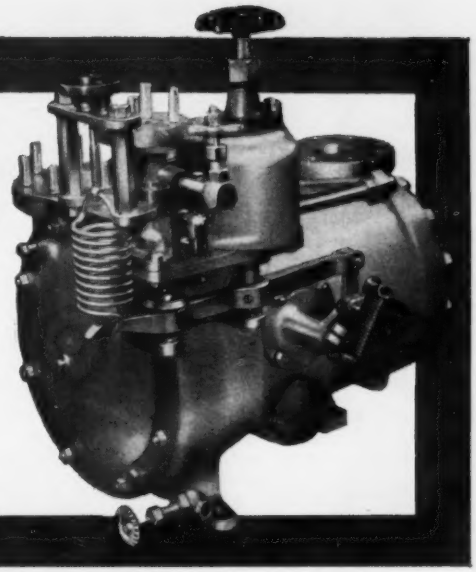
Assistant Editor

LATEST WATER TREATMENT EQUIPMENT and PRODUCTS: For full details on any of these items, circle key numbers on Reader Service card, p 227

220 **Keep water crystal clear,** eliminate sludge and suspended solids with new boiler-water control system. Boiler water is continuously recirculated through a special side-stream filter, manufacturer states, reducing suspended solids to nearly zero. Savings up to 20% on fuel consumption, 75%

Complete Pump, Turbine and Controls

COFFIN IND TURBO PUMPS



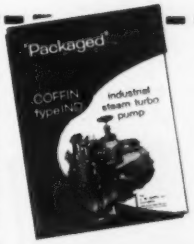
PACKAGED — integral design of the IND Pump results in a compact, highly efficient unit which mounts impeller and turbine wheel on a short, rigid shaft. The unit is equipped with complete controls for constant or differential pressure regulation.

APPLICATIONS — compact and highly efficient, the Coffin type IND Steam Turbo Pump is designed for General Boiler Feed or any other pumping service where medium volume and high pressure is required.

SPECIFICATIONS-

Capacities	to 180 GPM	Height 32"
Discharge Pressures	to 350 PSIG	Width 25"
Liquid Temperatures	to 300°F	Length 32"

For special installations these ratings may be exceeded.



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For more facts circle 943 on Reader Service card, p 227

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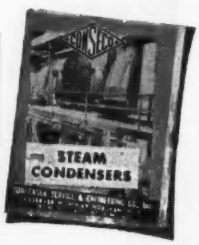

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Bulletins on all CONSECO PRODUCTS on request.

on treatment chemicals, blowdown heat and water losses, and up to 100% on contaminated-condensate losses are reported by the manufacturer. This system is available in models for a wide range of steam boilers. — Sparkler-Filtrion Corporation

221 **Low-cost blowdown** and sampling system gives advantages of continuous blowdown, but under manual control. Basic unit comes without cabinet and sampling sink, costs only $2200 to $2800. Package includes: (1) volume-control valve (2) strainers with drain manifold (3) insulated flash tank with drainer, high-level alarm and safety valve (4) sample cooler (5) main heat exchanger and (6) sight flow indicators. Pre-engineered unit is supplied ready to install in capacities up to 6000 lb per hr of total blowdown.—Fred H Schaub Engineering Co

222 **Latest packaged** salt-water distiller efficiently turns the ocean into fresh water. It's a combination basket, jet-compression flash evaporator operating on self-contained thermodynamic cycle. Rated capacity is 10,000 gpd; at least 90 gal distillate per gal fuel. Basket-effect shells and basket heating sections are made of monel, flash storages are glass fiber, distiller condenser has steel shell, aluminum tubes and cast-iron heads, flash condenser has aluminum tubes, jet compressor is cast iron. Bronze components are downstream of aluminum parts to prevent copper-corrosion attack, manufacturer claims.—Emhart Mfg Co, Maxim Div

223 **Seawater distilling machine** comes in sizes ranging from 500 to 100,000 gpd. Efficiency is increased: less fuel is needed and scaling problem has been eliminated without any acid feed, manufacturer reports. Low-temperature operation promises mechanical simplicity and low corrosion rates. — Mechanical Equipment Company

224 **Flash evaporator** produces up to 630,000 gpd of fresh water from salt water. Original of this 4-stage mammoth was built for the Shiekdom of Kuwait. It works

Begins on page 299

by reducing pressure on heated water below vapor pressure, causing flash evaporation—vapor is then condensed. Closed cycle permits chemical treatment, so you get continuous operation without shutdown for removing scale, maker claims. — Westinghouse Electric Corporation

225 **Compact deionizer** produces up to 120 gph of deionized water. Bags of mixed ion-exchange resin are removable. When they're exhausted, just lift them out and exchange for factory-regenerated refills, manufacturer states.—Elgin Softener Corporation

226 **Cooling-water chemical feeder** continuously proportions liquid chemicals for corrosion, scale prevention. Feeder eliminates daily chemical charging, supplying from 1/10 to 1 gal specially filtered chemical every 24 hr. Use it with 10- to 400-ton cooling towers.—The Bird-Archer Company

227 **New distillation process** extracts fresh water from the sea for less than 85c per 1000 gal, maker claims. Plant uses conventional fuels, is linked with electric-power generating units. — Griscom-Russell Company

HERE ARE THIS YEAR'S WATER-TREATMENT DESIGN AIDS: For your free copies, just circle the key numbers on Reader Service card provided on p 227

644 **Evaporators** are detailed in 12-p bulletin HYT-101. Includes tables, drawings and photos. Yuba Consolidated Industries, Inc

645 **Ultra-pure water** for nuclear plants is discussed in 4-p technical reprint T-162. Reasons for this extreme purity are listed. Graver Water Conditioning Co

646 **Sodium sulfite** use for removing oxygen from boiler feedwater is topic of new bulletin. Monsanto Chemical Company, Inorganic Chemicals Div

647 **Chemical processing** is subject of 6-p bulletin WC-120. Lists latest services available. Graver Water Conditioning Co

648 **Hydrazine product** for treating boiler feedwater is detailed in 4-p bulletin 589. Betz Laboratories, Inc

continued

For General Use buy RIDGID Heavy-Duty Pipe Cutters

Factory tested for perfect tracking, here's your best cutter buy for hand use. Extra-long shank protects threads, gives fast, easy adjustment. Large handle for sure grip . . . more leverage. Strong, special malleable frame won't bend or warp. You'll also need the RIDGID Wide-Roll Cutter, that tracks perfectly at high power-drive speeds, and the RIDGID 4-Wheel Cutters, that give quick, clean cuts in tight places with only quarter turns.

For Tubing and Thin-Wall Conduit buy RIDGID Tubing Cutters

Exclusive fold-in reamer on Nos. 10, 15 and 20 protects hands and pockets . . . reams full cutter capacity. Single thin-blade wheel gives quick, clean cuts. Rollers smooth tubing ready for soldering.

Only special No. 315 is 3-wheel cutter for fast cuts in hard-to-get-at places.

There's a RIDGID Cutter to save you time on every job. Call your Supply House today!

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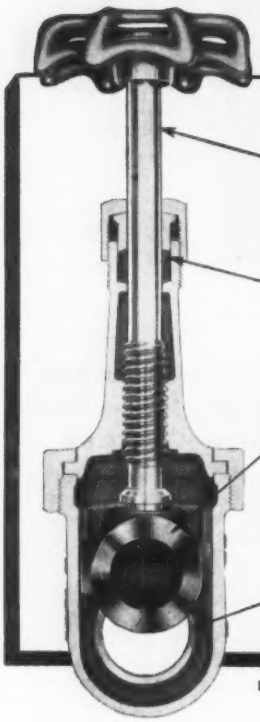
The Ridge Tool Company, Elyria, Ohio, U.S.A.

For more facts circle 945 on Reader Service card, p 227

Outstanding Valve performance with

KENNEDIZED DISCS

an entirely new development in bronze gate valve construction that extends service life beyond comparison . . .



PROVEN BY USE!

KINALLOY STEM . . .

Exclusive KENNEDY alloy that prevents dezincification and corrosion and provides smooth, non-galling threads and bearing surfaces. In a rugged use test, this stem withstood a mechanical loading of 18 foot-pounds closing torque and after 25,000 cycles was like new!

PACKING . . .

New type packing made of molded graphite asbestos with a Buna "N" binder required no replacement during or after 25,000 cycles.

KENNEDIZED DISC . . .

In punishing use tests, the super mirror finish of the KENNEDIZED disc actually improved with wear! Disc showed no galling or other wear marks after 25,000 cycles at 150 lbs. saturated steam pressure. This remarkable wear resistance is combined with an extremely low coefficient of friction, smooth sliding properties, excellent anti-seizure characteristics and corrosion and galling resistance. Tests and in-use results prove these discs set a new and unmatched high standard in valve performance.

SEAT . . .

Due to the low coefficient of friction and smooth sliding properties, the action of the KENNEDIZED disc actually improved the finish on the seat. Here, again, no galling was found on the seat after 25,000 cycles.

For the complete KENNEDIZED DISC story, write for Bulletin 574.

Fig. 525KD
125-Pound S.W.P.
Bronze Gate Valve.

KENNEDIZED DISCS
NOW AVAILABLE IN THESE KENNEDY VALVES . . .

FIG. 427KD
125-Pound S.W.P. Bronze Gate Valve—Non-Rising Stem, Inside Screw, KENNEDIZED Wedge Disc.
WORKING PRESSURES: Saturated Steam, 125 lbs.; W.O.G., Non-Shock, 200 lbs.

Fig. 525KD
125-Pound S.W.P. Bronze Gate Valve—Union Bonnet, Rising Stem, Inside Screw; KENNEDIZED Wedge Disc.
WORKING PRESSURES: Saturated Steam, 125 lbs., W.O.G., Non-Shock, 200 lbs.

Fig. 78KD
200-Pound S.W.P. 550° F. Bronze Gate Valve—Union Bonnet: ¼"-2"; Bolted Bonnet: 2½"-3"; Rising Stem, Inside Screw; KENNEDIZED Wedge Disc.
WORKING PRESSURES: Steam at 550° F., 200 lbs.; W.O.G., Non-Shock, 400 lbs.

Fig. 518KD
300-Pound S.W.P. 550° F. Bronze Gate Valve—Union Bonnet: ¼"-2"; Bolted Bonnet: 2½"-3"; Rising Stem, Inside Screw; KENNEDIZED Wedge Disc.
WORKING PRESSURES: Steam at 550° F., 300 lbs.; W.O.G., Non-Shock, 600 lbs.

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Water treatment

Begins on page 299

649 **Water conditioning** with ion exchangers is discussed in 60-p handbook A-5. Softening, dealkalizing, demineralizing processes are discussed from standpoint of equipment, chemicals needed, quality of water. National Aluminate Corporation

650 **Clarifiers and thickeners** for handling liquid-solids separation in water, sewage and industrial waste treatment are discussed in 16-p bulletin W-800. Infilco Inc

651 **Dialysis system** to treat acid liquors is covered in 6-p bulletin WC-121. Graver Water Conditioning Co

652 **"Handbook of Demineralizing"** is title of 40-p book 5800. Compares various methods of treatment—demineralizers *vs* evaporators, different types of cation and anion exchange materials, costs. Includes flow diagrams, installation and equipment photos. Cochrane Corporation

653 **Feedwater equipment** design and treatment methods are discussed in 8-p technical reprint T-161. Graver Water Conditioning Co

654 **Water-treating equipment** is discussed in 24-p booklet 615. Covers manual and automatic zeolite water softeners, demineralizers and deionizers, dealkalizers, deaerating heaters. Elgin Softener Corp

655 **Zeolite softeners** are covered in 12-p bulletin. Charts, diagrams aid selection. General Filter Company

656 **Deaerating systems,** boiler-feed systems and pumps, other accessories are subject of 20-p catalog 55-C. Selection guide helps plant owner choose best system. Fred H Schaub Engineering Co

657 **Packaged deaerators** for small and medium boiler plants are topic of 4-p booklet 4528. The Permutit Co

658 **Jet-tray deaerators** are subject of handy 4-p bulletins 201, 202, 301, 302, covering left- and right-hand mono- and duo-pack units. Kittredge Engineering Company

659 **Stainless-steel deaerators** are discussd in 4-p bulletin 101—informative specs, diagrams included. Kittredge Engineering Company

660 **Condensate filtration** is topic of 8-p technical reprint T-172. Paper describes supercritical, nuclear and monotube-boiler installations. Graver Water Conditioning Co

661 **Water, sewage** and industrial waste-treatment equipment is

For more facts circle 946 on Reader Service card, p 227

The Power Plant Engineer Said: "I WOULDN'T KNOW..."

INQUIRING REPORTER: So you use Nalco System water treatment ... How often are your boilers turbined? *

ENGINEER: I wouldn't know—only worked here seven years.

* You recognize the Engineer's answer as a twist on the old one about *How-often-do-you-get-a-raise-around-here.* Our excuse for bringing it up is that the engineer's answer applies to hundreds of plants using Nalco water treatment. New plants, starting boilers from scratch with Nalco, report years on line, *billions* of pounds of steam generated in boilers that have *never* been turbined ... and probably never will be. Older plants, where turbining was as routine as checking the draft gauges, now open boilers only to show the inspectors.

These Nalco *results* can quite possibly be duplicated in your plant, regardless of the kind or severity of your water treatment problems ... or the size of your operation. Write or phone, now, for a fast start toward permanent water treatment security.

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Water treatment

Begins on page 299

listed in catalog 952. Drawings, charts and installation photos illustrate water and bar screens, collectors, settling tanks. The Jeffrey Manufacturing Company

662 **Fluidics buyers' guide** is new 16-p handbook 980. Gives application photos, engineering data. Pfaudler Permutit Inc, Pfaudler Co Div

663 **Water-treatment line** is discussed in 4-p bulletin SM-1013. Shows clarifiers, mixers, contactors. Process Engineers, Inc

664 **Multiple-bed** water conditioners are covered in 4-p brochure. Water Refining Company, Inc

665 **Automatic** side-stream boiler-water control system is topic of 6-p folder 340B-1. Equipment photos and drawings, a system diagram, specs and features are included. Sparkler-Filtrion Corp.

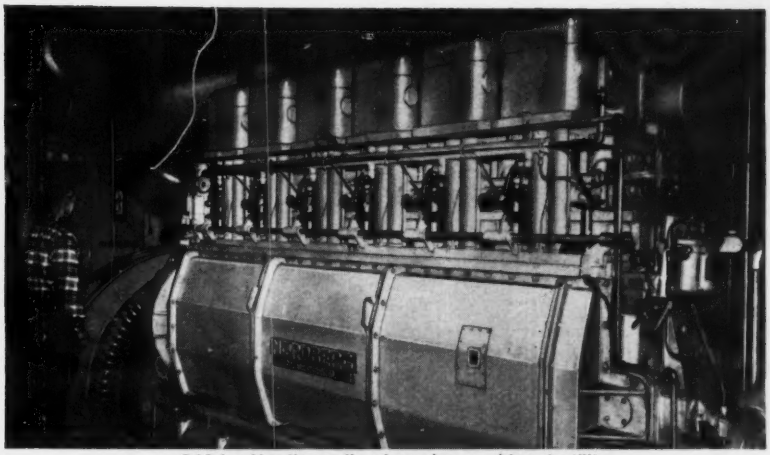
Seven-year plan for Russia will boost primary energy yield of natural gas from 6 to 18%, drop coal from 62 to 44%. Energy balance may be similar to that of U.S. by 1975.

Britain's Central Electricity Generating Board plans a 1-million-kw nuclear-power station on River Severn in southwest England.

"No trouble keeping your beady little eyes on that gage, eh Fester?"

For more facts circle 948 on Reader Service card, p 227

Cut power costs with NORDBERG ENGINES



840 kw Nordberg diesel serving a midwest utility.

Two 2500 kw Nordberg diesels serving an eastern utility.

2285 kw Nordberg diesel, one of three in a southern utility.

FOR STANDBY SERVICE

If lack of sufficient power makes it difficult to hold generating costs "down," and standby reserve "up," it will pay you to investigate the advantages of Nordberg engines. These efficient prime movers are easily installed independent of existing power facilities, go on the line quickly, and generate low cost power under all load conditions.

FOR PEAK LOAD SERVICE

If your base generating station is having difficulty "topping the load" at an economical figure, follow the example of many utilities who have assigned peaking problems to Nordberg engines . . . and in doing so have also added desirable generating flexibility and standby protection while amortizing their investment through more profitable operation.

FOR BOOSTING VOLTAGE

If your load has grown beyond the capacity of the existing transmission system and if there is difficulty maintaining voltage in outlying areas, Nordberg engines can give you the increased capacity at low cost per kwh. These efficient units are easily installed, and can be readily tied into the line at strategic locations to boost the voltage.

We will welcome your inquiry and the opportunity to discuss the advantages of Nordberg engines for your specific power requirements. Write for further details.

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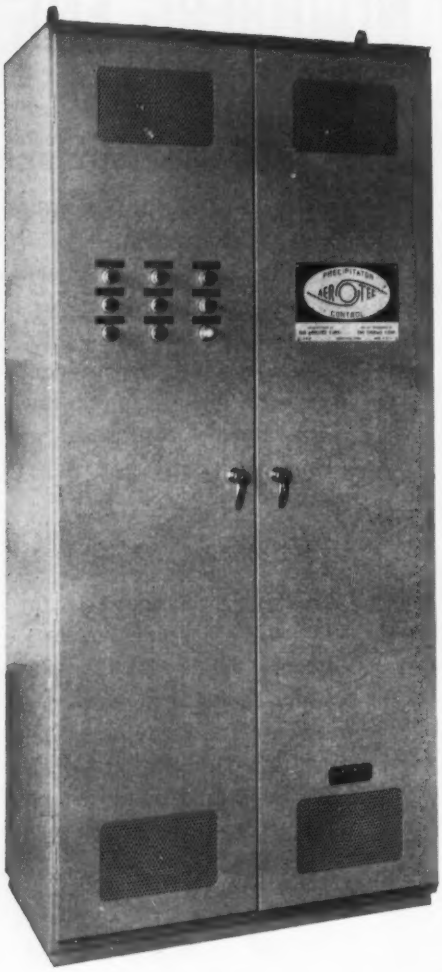
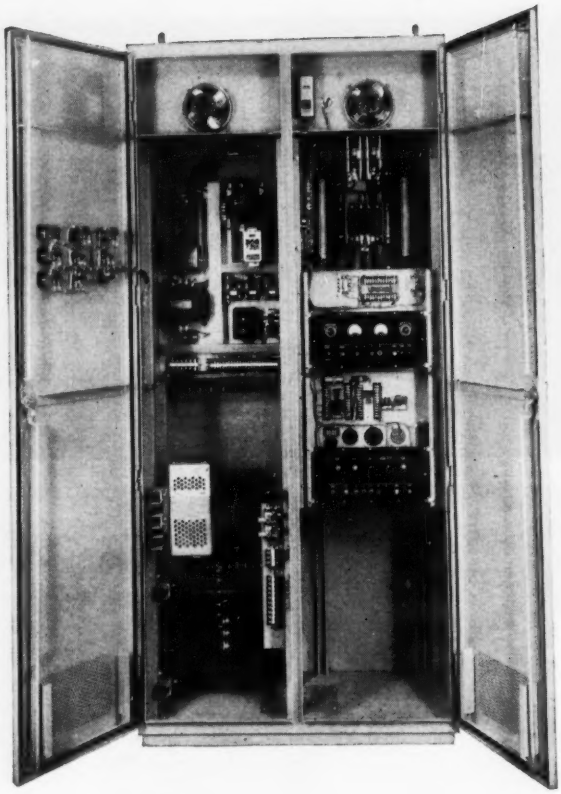




Aerotec Electrical Precipitator Control Monitors Optimum Power 120 Times Per Second

This Aerotec precipitator control takes a look at voltage-current conditions *120 times per second!* It makes adjustments at the same fast speed—so you always get peak efficiency.

Developed by Aerotec Industries, this complete, compact unit operates on an entirely different basic principle of automatic control. It has proven itself in numerous installations by boosting power levels to give striking improvements in stack gas appearance.

Heart of the automatic packaged control is a pair of power thyratron tubes connected in inverse parallel. Results: Rapid monitoring with instant response . . . High-speed voltage adjustment . . . Quick cut-off that eliminates destructive arcing by quenching excessive sparking.

If your problem is air pollution control, call on Aerotec Industries 30 years' experience in dust collection. Write for more information on mechanical, electrical or series collectors.

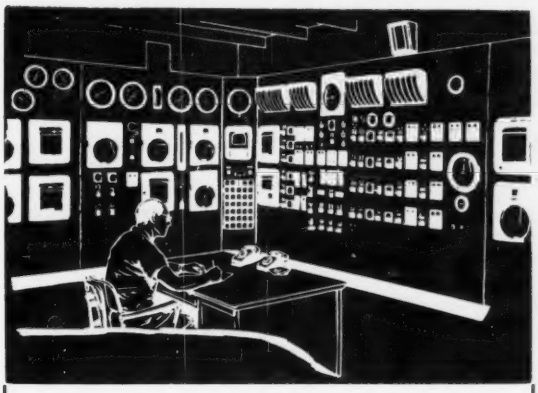
AEROTEC INDUSTRIES, INC.

INDUSTRIAL DIVISION, DEPARTMENT P, GREENWICH, CONNECTICUT

FAN-STACKS • BLOWERS • CURTAIN DAMPERS • AIR PREHEATERS • MECHANICAL AND ELECTRICAL DUST COLLECTORS FOR INDUSTRIAL PROCESSES AND FLY ASH • GAS SCRUBBERS FOR CHEMICAL PROCESSES AND NATURAL GAS TRANSMISSION LINES

For more facts circle 950 on Reader Service card, p 227

INSTRUMENTATION



Instrumentation and control trends reflect advances in performance characteristics of basic power-services equipment. Developments in missile field have resulted in new instruments that apply to the power field. High-speed data-handling equipment, often in modular form, is now available for use in built-up, centralized control of power services.

To complement data-handling units, new controls feature super-compact arrangement and standardized input signals. Supervisory control systems utilizing these new components find use in many plants with spread-out power services.

Measuring instruments, particularly portable ones for performance checking, now offer plant engineers precise, high-speed equipment for control calibration and instrument maintenance. Automation will force more engineers to invest in test instruments to maintain high levels of control performance.

L. E. Stewart

Assistant Editor

Recent equipment developments: Circle key numbers on Reader Service card, page 227, for more details

228 **Frequency type telemetering** system sends data over any communications channel. Miniaturized, transistorized system will transmit temperature, pressure, liquid level, flow, megawatts and other variables in the form of electrical signals. A millivolt-to-current transmitter, a current-to-frequency transducer and a frequency-to-current transducer make up the system. For current, voltage or mw measurements a thermal converter is used with the transmitter.—Minneapolis-Honeywell Regulator Company

229 **Self-contained TV camera** automatically accommodates a light range of 120/1, with 50% change in video output level. Camera adjusts its own beam, target and electrical focus to optimum values.—Thompson Products, Inc

230 **Scanning control** monitors up to 24 stations in sequence, instantly indicating an abnormal condition at any point. Usual signal is a red warning light but an alarm can be added or device can be set to shut down problem equipment. Scanner was first developed for watching temperatures from −200 to +3000 F, now monitors most measurable variables. Selector switch checks stations in order, 12 per minute.—Assembly Products, Inc

231 **Flexible medium computer** can process data and do scientific computations simultaneously; parallel processing means the central unit can perform up to eight separate jobs at once. There's built-in traffic control letting computer communicate with eight input and output devices at once—punch-card readers, printers or magnetic-tape units. This eliminates bottlenecks caused by slower supporting equipment. Monthly rental for this computer starts at $11,000.—Minneapolis-Honeywell Regulator Company

232 **Analog-to-digital converter,** designed to be air-borne, weighs only seven lb and is just a little larger than a milk bottle. Solid-state converter makes high-reliability measurements in data-acquisition and reduction systems. Added feature is a built-in automatic error-checking system.—C G Electronics Corporation

233 **Fault-finder alarm system** features solid-state components, no moving parts. System monitors electrical substations and industrial-plant operations at long or short distances. Remote scanner-transmitter checks conditions at 20 points.—Applied Science Corporation of Princeton

234 **Plug-in controller subassembly** contains all equipment needed to program any standard flame-failure control. Face plate on flush-mounted timer shows its position at all times. You can replace unit in the field in less than one minute.—Compact Controls Co, Inc

235 **Boiler-water-level gage magnifier** is used with closed-circuit TV. It comes prewired with lamps installed. Mount it using only a screwdriver and end wrench. This unit is reported to magnify four times, weigh two lb, cost you just $187.50.—Diamond Power Specialty Corp, Electronics Div

236 **"True-mass" flowmeter** measures the flow of liquid or gas directly in pounds. Where conventional methods measure fluid volume, then correct for temperature, pressure and density, this unit senses mass directly with accuracy of ±1% of reading. Compatible with automation, it can emit a series of electrical pulses to operate remote counters, printers or totalizers. It will operate from an unregulated power supply without appreciable loss of accuracy, according to the manufacturer. First production units, scheduled for early next year, will meter gasoline, refinery and natural gas, oxygen and nitrogen, butane and propane. Future adaptations should produce units to meter the lighter gases and high-temperature corrosive or cryogenic fluids—steam and acids.—Black, Sivalls and Bryson, Inc (for natural-gas applications) and General Electric Co

237 **A single Btu meter,** reportedly the first mechanical unit developed exclusively for the heat pump, tots up precise amount of heat absorption or cooling used. Now tenants can be charged for heating and cooling sup-

plied from a central heat-pump installation in exact proportion to use. Btu meter measures at points where water enters and leaves tenant's space, changes automatically from heating to cooling by means of an electric switch. It's designed for shopping centers, office buildings and labs, and is also useful for process work. —Air Conditioning Equipment Corporation

238 **Sampling and telemetering system** uses solid-state components for reliability, operates unattended in power-distribution and utility applications, oil and gas pipelines, processes. System transmits remote measurements over a single teletype, voice or microwave channel; its output signal can be used for computer control. Transmitter and receiver are reported to handle as many as 30 data points with over 99% accuracy.—Applied Science Corporation of Princeton

239 **Automation programer** controls, indicates and records without cams, cam followers or function generators. Unit "reads" a pencil-drawn program chart, controls your process accordingly, superimposes record of performance on same chart for easy reference.—Research, Incorporated

240 **Temperature-monitoring system,** using thermistor sensing devices, signals when temperature at any protected point reaches a preselected high or low. It can be used for checking bearing temperatures in generators, turbines, pumps and other rotating equipment as well as protecting processes and pipelines. Temperatures of 125 to 600 F are handled; all points are monitored continuously and simultaneously.—Fenwal Incorporated

241 **Computerized process-control** system offers a full range of control, from simply providing info for an operator to evaluate to automatic control of entire process. You can use it to gradually change from manual operation to a completely computer-controlled plant. Developed around a rapid-response computer, system expands as you add new instruments, techniques to your plant.—Librascope Incorporated

242 **Closed-circuit TV monitor** has polaroid filter, 14-in. aluminized picture tube. Camera's built-in automatic light adjustment instantly compensates for variations in light level up to 1000/1. Geometric distortion is reportedly never over 2%.—Cohu Electronics, Inc, Kin Tel Div

243 **Gas-density switch** detects gas leakage in closed volumes, signals gas densities in processes subject to wide temperature variations.—Newark Controls Co

244 **Bellows flowmeter** will measure flow or liquid level. Features of the new unit are fast, accurate damping adjustment, seamless stainless-steel bellows, positive overload protection to full line pressure. Unit is corrosion resistant and safe for hazardous atmospheres, according to the manufacturer.—Minneapolis-Honeywell Regulator Company

245 **Electrical gas flowmeter,** calibrated for true mass flow, can be used with some flammable and explosive mixtures. Development of this Underwriters' Lab-approved meter makes possible remote indication of mass flow in gas lines. Extremely sensitive unit detects small leaks for a bonus in system safety. Model *F-1-6* costs $395.—Hastings-Raydist, Inc

246 **Btu meter** records, indicates and integrates Btu loss or gain of a flowing liquid. Temperature differential and liquid flowrate are also recorded on the handy chart. Applications include heat-transfer measurement in hot-water generators, cooling towers, refrigerating systems. —Hays Corporation

247 **Boiler-water meter** mounts remotely, indicates and records total feed to boiler for a permanent record of output. It's rugged and versatile, maker states. Daily feed loads can be read on continuous-integrating recorder, instantaneous load checked on visual face, peak load found on 24-hr chart.— Henszey Company, Power Plant Equipment Div

248 **Mass flowrate meter** measures rate of flow independent of pressure and temperature. Primary element is an annular orifice, with area controlled by a sealed bellows unit. Temperature and pressure of flowing gas determine length of bellows. Element is available in stainless steel or with phosphor bronze or brass bellows for low pressures.—National Instrument Laboratories, Inc

249 **Multipoint nonindication controller** is useful where continuous control is important but you don't need a chart record. Unitized construction makes it possible to add or subtract control units for 1-, 2-, 3-, 4-, or 6-point operation. Flexible controller has an electronic amplifier, operates on the null-balance principle. A special potentiometer constant-current source means you need no batteries, standard cell or standardizing mechanisms; source comes adjusted to initial accuracy of 1/20%.—Daystrom Incorporated, Weston Instruments Div

250 **Universal flame detector,** reported to be industry's first, is used on all types of commercial and industrial heating and processing burners. Heart of the system is an ultraviolet-sensitive tube. Amplifier circuit adds up impulses of electrical energy generated by tube as it counts ultraviolet rays in all types of flame—from all fuels including gas-oil combinations. Detector costs $120.—Minneapolis-Honeywell Regulator Company

251 **Pneumatic recording controller** for industrial applications uses a 15-lb air line to actuate air-operated steam valve. It comes in ten ranges, running from −30 through +1100 F. The 10-in. circular chart is electric or spring-driven for 24-hr, 48-hr or 7-day periods.—The Partlow Corporation

252 **Pressure control,** recommended for air or gas applications, weighs only 1¾ lb. Useful for limited-space applications—mounting on wiring channels, for example—it measures 4⅛x3⅛x2⅞ in. Features are external adjustment, repetitive trip point, visible calibrated dial. Operating range is 1 to 20 psig adjustable.—The Mercoid Corporation

253 **Flexible multipoint recorder** is low-cost, yet it has built-in versatility, handles 2 to 24 points with simple

plug-in adapter units. To vary number of points, a 3-min operation, just change a plug-in unit, replace the dial indicator and print wheel—they're mechanically geared with selector switch.—Daystrom Incorporated, Weston Instruments Div

254 **Liquid-level control pilot** features an adjustable proportional band. Single-knob adjustment lets you set the band while system is in operation without affecting liquid-level set point. Differential-pressure sensing method is reported to be unaffected by surface turbulence.—Leslie Co

255 **Pressure gage** is dead-weight tested, guaranteed accurate within ±¼% of maximum dial reading of entire range. Various designs come in 4½-, 6- and 8-in. sizes.—Marsh Instrument Company

256 **Ultrasonic thickness tester,** a completely self-contained unit, weighs less than five lb counting batteries, probe, harness, cable and earphones. Nondestructible thickness measurement of most metals, glass, ceramics and plastics from one side is handled by the versatile instrument. Since power source is self-contained the tester is reported to be ideal for field corrosion inspection. Panel meter reads direct for steel, aluminum or copper, has a fourth position to calibrate for other materials. Claimed accuracy is within 3 to 5%.—Branson Instruments, Inc

257 **Portable corrosion tester,** a battery-operated lightweight unit, reads directly in microinches of corrosion. It's ready for service in paper and pulp plants, chemical and plastics manufacturing, all kinds of industrial cathodic-protection programs. Tester works by applying ac to the probes, eliminating polarization. Convenient single knob controls sensitive transistorized bridge circuit operating on the null principle.—Soiltest, Inc

258 **X-ray eyes** of this 150- to 250-kv industrial X-ray control produce clearly defined images through ⅛-in. aluminum, 4-in. steel. Circuitry has built-in overload and overvoltage protection—either condition automatically stops instrument, while an indicator light signals overload and excessive voltage shows up on direct-reading kv meter, according to manufacturer.—Westinghouse Electric Corporation, X-ray Dept

259 **Solid-front gage** protects personnel in case of tube failure. A full-nylon back blows out at case pressures less than two psi, but front shield is an integral part of rigid case construction and can't blow out. There's full access for easy adjustment.—Crosby Valve & Gage Company

260 **Gas analyzer** measures concentration of one gas in a multicomponent mixture. Thermal-conductivity principle of measurement is used, taking into account differences in convective heat losses from hot filaments. You can have this analyzer calibrated for any gas in narrow (0-1%) or wide (0-100%) ranges. Use it to measure CO_2 in flue gas or to control process or combustion.—Mine Safety Appliances Company

261 **Quick oxygen reading** in high-purity water is made with this oxygen comparator using the indigo-carmine method. Place sample in bottle on handy support, compare with a rotating 6-color disk matching oxygen at 0, 5, 10, 15, 25 and 50 ppb. Unit is made of white Plexiglas to prevent color interference. It measures 4x8x1 in., sells for $19.00.—R L Johnson

262 **Boiler-water analyzer** makes colorimetric analysis simple and inexpensive. Unit has no moving parts, needs no electric or pneumatic power. Untrained operator makes spot checks by visually comparing gradations on a standard color chart with sample in instrument's optical cell. Accuracy is said to be adequate for normal field testing—within 2 to 5% of reading.—Florida Instrument Company

263 **This handy plastic tie** binds faster, neater than old string-tie method. A wide range of wiring-bundle diameters can be fastened in 30% less time because flexible tie has a ratchet-like self-adjusting design. Holding ability is reported to be almost equal to basic tensile strength of the nylon-base Moldarta material. There's also a plier with special jaws designed for easy gripping.—Westinghouse Electric Corporation, Component Products Dept

264 **Rough-service thermocouples** aren't daunted by severe demands of nuclear reactors, melting furnaces. They're made in combinations of copper-constantan for temperatures down to −300 F, rhodium-platinum to stand up at over 1600 F. Conductors are encased in ceramics, surrounded by chemically clean metal sheaths. Insulation resistance between wires and sheath ranges up to 100 megohms at 500-v dc; dielectric strengths run up to 2000-v ac, maker reports.—Continental Sensing, Inc

265 **Protect your manometers,** draft gages, electrical pressure switches with this handy device. Designed for atmospheric or relative-pressure-system applications, unit is repeatable, will reopen after sealing at 2% below cutoff point. Four ranges span −15 to +85 psig.—Industrial Engineering Corporation

266 **Gas-valve shutoff delay** prevents valves from closing during momentary voltage drop. To eliminate resetting and keep production on schedule, units will hold fuel-shutoff valves open for five sec in case of power fluctuation due to thunderstorms or power changeover. Model *A* works on 440-, 220- or 110-v 60-cycle current, model *B* features an additional interlock for use with other types of safety devices, model *C* is a special design for flame-safety controls.—Michigan Controls Company

CONTROL VALVES and ACTUATORS

267 **Canned control valve** handles primary liquid-sodium coolant lines leading to blanket section of the Enrico Fermi Atomic Power Plant. Manually operated 6-in. units serve as variable throttling orifices without complete shutoff—flow can be regulated as needed with no danger of closing which would stop blanket coolant flow. Control range is 5 to 20% of total flow. Entire inner assembly of the valve is enclosed in a sealed container; an automatic manipulator removes it as a unit without draining the system. Assembly has two

leak-detection chambers, each fitted with an electrical detector. Units are made of Type-304 stainless steel suitable for 150 psi, 1000 F. Throttling surfaces and stem guide are of stellite. Stellite ball bearings and races are also used to support rising stem, since lubrication is prohibited.—Blaw-Knox Company, Copes-Vulcan Div

268 **Universal pressure-reducing valve** controls compressible or incompressible fluids without design change, takes steam, water, gas, oil, air in stride. You interchange three springs to get precise pressures between zero and 125 psig without removing valve from service. Unit gives step reductions of 600 to 1 psi. Single-seated valve provides full port opening, positive dead-end closing or any degree of modulation for precise downstream pressure control or continuous demand.—The C E Squires Company

269 **Designed for industry's** hydraulic-control systems, flow-control servovalve operates on 2-stage force-balance feedback principle. Large field-replaceable filter is integral in a cast-Meehanite body. Four sizes range from 1 to 10 gpm with 1000-psi valve drop, 20-ma input.—Moog Valve Co Inc

270 **Master control valve** regulates complex industrial and water-conditioning processes by the turn of a dial, maker reports. Hydraulic pressure actuates as many as 36 remote valves from a single location, turning them off and on in any preset sequence. Your process can often be used as the pressure source to actuate these control valves.—Automatic Valve Systems Co

271 **Direct-lift solenoid valve** is made with only one moving part. The 2-way unit takes steam, air, gas, light oil, water and other noncorrosive gases in its stride, for industrial heating control, vacuum and general service at mainline pressures to 40 psi.—Automatic Switch Company

272 **Single hydromatic control valve** is manually operated by turning lever to backwash, brining, rinse or service without using gate valves. Body is cast iron with removable cover. Inside are six diaphragm-operated valves, hydraulically controlled by a small pilot rotary-disk slide valve. Unit is reported to be nonleaking, nonscoring and easily maintained to save you time and money.—Cochrane Corporation

273 **High-velocity air valve** operates without motors or any kind of linkage mechanism. A 15-psi pneumatic control system uses airfoil vanes, each enclosing a sealed neoprene actuator connected to control air. As air pressure increases, actuators inflate and expand vanes. The open space between valves constricts and air flow is throttled. When expanding vanes make contact you get complete shutoff with minimal leakage. Air capacities range from 1500 to 9600 cfm.—Connor Engineering Corp

274 **Expansive force of Freon** vapor develops 500 lb in this actuator for valves or other final control elements. Freon-vapor force is opposed by 300-lb return spring force for a total stroke length of 1.5 in., response speed of 0.1 in. per sec. Precise, repeatable accuracy is achieved by varying bleed rate of Freon into a condenser.—Swartwout Company

275 **Steam-service regulators** come in two models to control atomizing steam pressure at an adjusted value higher or lower than fuel-oil pressure. Both types are made in ½-to 2-in. sizes, with minimum of moving parts, no internal adjustments.—Atlas Valve Company

276 **High-torque rotary actuator** provides low-cost control for variable-speed drives, valves, pumps, reactors and machine tools. A built-in precision potentiometer remotely indicates position on dial or meter or serves in automatic control circuits. Delivery is 200 in.-lb at 500 rpm; ratings to ¾ hp are available in single and 3-phase styles, ratings to 500 w in 2-phase servo types.—OPW Jordan

277 **Fuel-gas valve** provides straight-through nonturbulent flow and fail-safe shutoff. Sturdy unit offers on-off control or safety shutoff for boilers, heat-treating furnaces, drying equipment. Automatic- and manual-reset styles have self-cleaning seats.—General Controls, Inc

New design aids: To get copies of those you want, circle key numbers on handy Reader Service card, page 227

666 **Receiver** for temperature, pH and conductivity measurement, closed-circuit telemetering is subject of 8-p bulletin OE-1003. Hagan Chemicals & Controls, Inc, Controls Div

667 **Closed-circuit TV** equipment is topic of 8-p bulletin 6-103. Cohu Electronics, Inc, Kin Tel Div

668 **Analog computer** featuring "zipper" packaging is described in 18-p brochure and folder. Mid-Century Instrumatic Corp

669 **Digital instruments** are described in 4-p bulletin 19-36. Cohu Electronics, Inc, Kin Tel Div

670 **Industrial TV cameras** are illustrated in 4-p bulletin. Cohu Electronics, Inc, Kin Tel Div

671 **Automatically programed** remote-indication logging system for supervisory equipment is detailed in 8-p bulletin GET-2925. General Electric Company

672 **Data-processing** equipment for a broad range of functions is listed in brochure U-1363. Sperry Rand Corp, Remington Rand Div

673 **Pneumatic transmitter** for water, sewage and general industrial use is covered in 4-p bulletin 285.20A-1. B-I-F Industries, Inc

674 **Metal-tube rotameters** measure flow of hazardous or h-p fluids at temperatures to 400 F—4-p bulletin 19A gives details. Schutte and Koerting Company

675 **O-ring seal rotameter** is described in 4-p folder SS-111-2. Brooks Rotameter Company

676 **Panel instruments** are featured in 24-p illustrated catalog 3-15. Describes ac and dc meters, elapsed-time meters, shunts and current transformers. Dimensional drawings, tables of ratings and descriptive data are included. Federal Pacific Electric Company

continued

LIFETIME SERVICE BACKS UP OCOTILLO'S NEW LJUNGSTROMS®

Extremely compact and highly efficient, these baskets of heat transfer surfaces are the heart of the Ljungstrom. (The photo below shows one being lifted into position.) Every inch of these baskets is the approximate equivalent of one foot of a standard tubular heat exchanger. The combined surface of the Ocotillo Air Preheaters provides 263,600 sq ft of heating surface.

The new Ocotillo Power Plant, near Tempe, Ariz., employs four Ljungstrom Air Preheaters for its two 835,000 lbs/hr boilers. Dependability is built into these Ljungstroms, from their corrosion-resistance to their double-life reversible elements (shown in the photo above).

But one of the most important reasons why Ocotillo chose Ljungstrom is Lifetime Air Preheater Service. Throughout the life of each unit (units dating from 1923 are still in operation), Air Preheater engineers make regular calls to inspect the units and keep them in top operating condition.

What's more, Air Preheater provides rapid factory service, too. Here's an example: a customer called on a Friday morning requesting immediate shipment of cold-end seals for an Air Preheater. But regular fabrication time would take until the weekend, when no ordinary transportation would be available.

So Air Preheater went to work. Special trucking was arranged. And by a tremendous effort, fabrication was completed *on the same day the order was received . . .* and the customer received the necessary parts *only ten hours after his initial request.*

Fast response to emergencies and regular inspection throughout the life of each Ljungstrom installation are two of the many advantages Air Preheater provides its customers. Another is expert knowledge of boiler and preheater problems—and how to lick them—gained from over 35 years' experience. Perhaps these reasons explain why nine out of ten preheaters sold today are Ljungstroms.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

For more facts circle 951 on Reader Service card, p 227

SCHAUB DEAERATION
doesn't cost...it pays!

Removes feed water oxygen to a guaranteed .03 cc/liter

Assures a simpler system that costs less to own and operate

The Schaub .03 is, in fact, one of the simplest deaerators ever built, designed around a unique and more efficient operating principle that removes oxygen to an actual and GUARANTEED .03 cc/liter.

Fully vented operation at atmospheric pressure — combined with pinpoint temperature control and Schaub "live action" heating of storage water — provides a forceful breakaway of air molecules that assures more effective oxygen removal under widely varying load conditions. At the same time the special Schaub spray contact vent condensing principle practically nullifies steam losses.

The Schaub .03 is completely safe! It needs no premium cost pressure shell construction—requires neither adjustment nor attention during operation—and takes practically no maintenance whatever! Even the exclusive Chromasoid lining is guaranteed against shell corrosion failure for 10 years.

Finally, no pressure-vessel insurance premiums to pay — ever!

Whether you reckon in original cost or the operating savings you'll achieve, no other deaerator in the 3000 - 45,000 lb. range offers you so much protection for so little. For fuller information on the remarkable "hows" and "whys" and savings advantages of the Schaub .03 Deaerator method, send for Bulletin 1300.

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2105 S. Marshall Boulevard, Chicago 23, Illinois

Please send me, without cost or obligation, my personal copy of your Bulletin 1300 on Boiler Feedwater Deaeration.

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Company.....
Address.....
City.....Zone....State.....

Instrumentation

Begins on page 307

677 **Small-computer installation** and uses are discussed in 8-p paper S-509. Royal McBee Corporation

678 **Feedwater-control system** is topic of 8-p bulletin 530. Installation photos, charts, diagrams give details. Bailey Meter Company

679 **Nuclear-reactor** control-system instrumentation is described in 18-p technical publication N-03(1). Leeds and Northrup Company

680 **Flow tubes,** telemetering and supervisory control for process are topics of 8-p bulletin 100-R5. B-I-F Industries, Inc

681 **Newly designed manometers** are among units shown in 12-p catalog. Includes engineering data. Trimount Instrument Company

682 **Meter-relays,** how and why they work, are topics of 4-p bulletin S-1. Assembly Products, Inc

683 **Ring balance meters** are covered in 8-p bulletin MSP-160. Hagan Chemicals & Controls, Inc

684 **Purge rotameters** for indicating and manually controlling small flows are topic of 4-p bulletin 18P. Schutte and Koerting Company, Instrument Div

685 **Rotameter flow-rate transmitter** is described in 12-p booklet 170. Brooks Rotameter Company

686 **Dissolved-oxygen meter** and its components are covered in 4-p spec sheets 58-B627, -B631 and -B771. The Hays Corporation

687 **Steam meter** for 1- to 1½-in. lines is discussed in 8-p bulletin 400 - P25. Builders-Providence, Inc

688 **Variable-area** armored flowrater meter for h-t applications, gas and liquid service is subject of 4-p bulletin 10A1152. Fischer & Porter Co

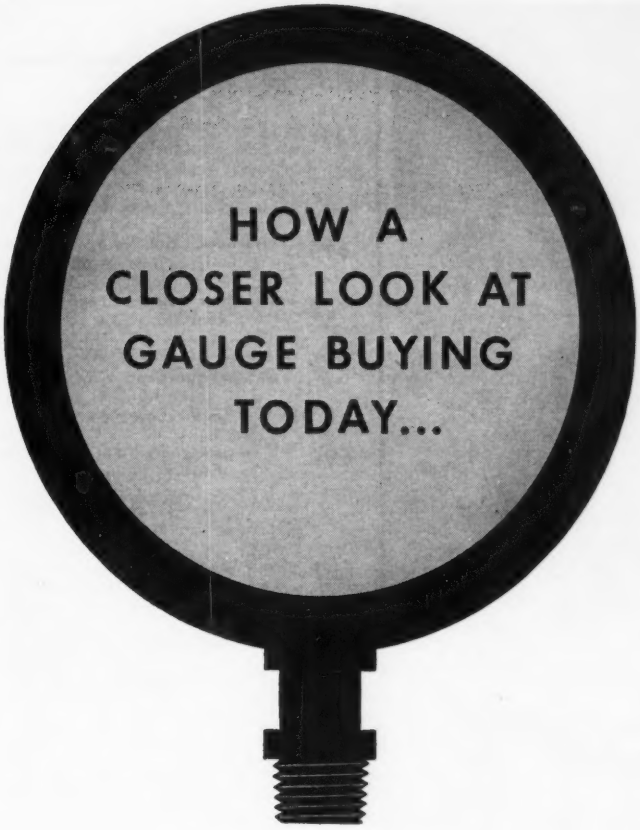
689 **Propeller meters,** other water-measurement and recording instruments are covered in 20-p bulletin 314-1. Sparling Meter Company

690 **Resistance thermometers** for temperatures to 1000 F are discussed in 36-p catalog EN-S4. Leeds & Northrup Co

691 **Manometers** are subject of 24-p catalog 2008. Units measure pressure and vacuum in plants and labs. King Engineering Corp

692 **Packaged automatic control** panels for gas-engine-driven compressors are described in 10-p bulletin 170. Clark Bros Co

693 **Recorders** and recording control-



can give you a tighter grip on gauge costs!

Been looking at gauge buying in your plant as "routine"? In terms of gauge performance you need, accuracy you get, price you pay . . . and how and where you buy? You can pick up real savings with a closer look at your gauge requirements . . . and at what United States Gauge offers. USG features the world's largest stock of indicating dial pressure gauges. Over 50,000 standards, plus specials, with all possible choices of sizes, case stylings, pressure ranges and case materials . . . up to and including the finest gauges of highest accuracy. One source meets 99% of your pressure gauge needs, with the exact gauge for the exact purpose at the right price. And one phone call to your USG distributor taps that source. See the Yellow Pages, or write for catalogs and name of your nearest USG distributor today.

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Division of American Machine and Metals, Inc., Sellersville, Pa.

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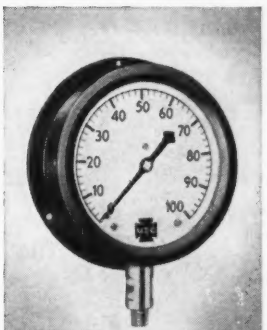
Replacement costs too high? Volume - priced, precision - built USG drawn-case gauges are the money-savers for replacement of any A.S.A. Grade B gauge in your plant (accuracy of 2% guaranteed). These standbys are specified by more than 60% of original equipment manufacturers today. Proof of USG reliability and value! *Write for Catalog 64A.*



Paying a premium for quality design, reliability? Check the new USG A-Line, premium design at savings up to 40% of premium prices! Meets A.S.A. Grade A Standards, including accuracy of 1%. Wide range of cases, sizes, movements, pressures cuts *you* in on A-Line savings wherever you need dependable gauge performance. *Write for Catalog 305.*

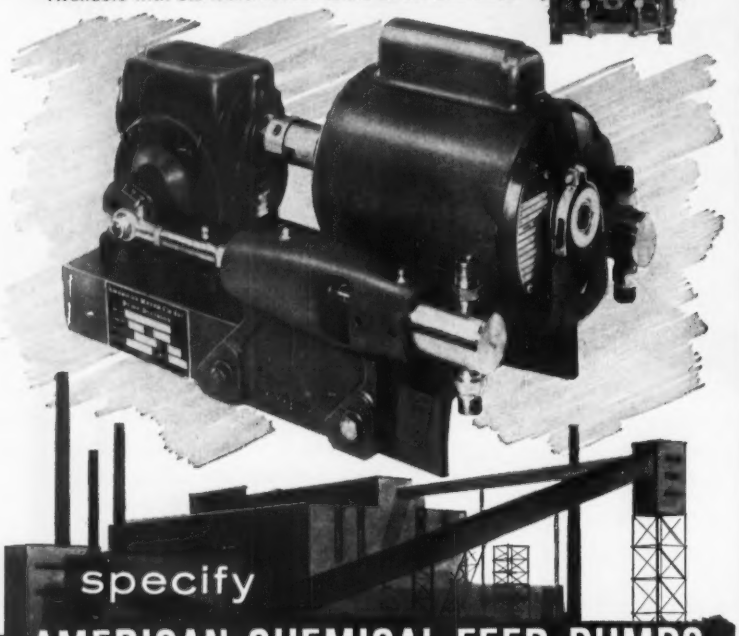
Paying for performance you don't get? Look at the USG Supergauge® line. Built like a watch to A.S.A. specifications for Grade AA Test Gauges, these gauges pay for themselves in long-lived, dependable performance and lower maintenance costs. Accurate to 0.5% of scale range. Full selection of case styles, sizes and options. *Write for Catalog 1819.*

Losing out on highest accuracy? USG Test Gauges are the elite of the industry, equalling or exceeding A.S.A. Grade AA standards with accuracy as high as 0.2 of 1%! Styles, sizes and case materials for all types of laboratory and test uses. You can't buy higher quality and precision in a test gauge! Get your money's worth at USG. *Write for Catalog 400*

For more facts circle 953 on Reader Service card, p 227

for accurately metered water treatment

Available with standard feeder tanks of various sizes



specify

AMERICAN CHEMICAL FEED PUMPS

Want *low initial cost, design simplicity, accurate control* and *minimum maintenance cost?* Get them all with American Series 100 controlled capacity pumps!

Series 100 pumps move specific volumes of fluid with a repetitive metering accuracy of ± 1%, when operating between the limits of 10% to 100% of stroke length. A screw adjustment on the crank provides easy, accurate stroke regulation for capacities ranging from .65 gph to 13.10 gph at a maximum pressure of 1000 psi on Series 100 Simple model. Duplex models have double that capacity.

- Spherical self-aligning bearings on crank and crosshead handle greater radial and axial thrust loads
- Nylon dust covers keep dust and dirt from bearing surfaces
- Crossheads of hardened and ground steel ride on cast iron
- Easily adjusted screwed packing glands
- Interchangeable liquid ends
- Heavy duty reducers
- NEMA frame motors

These quality features make American controlled capacity proportioning pumps the most dependable, economical answer to your water treatment needs.

AMERICAN® METER COMPANY

INCORPORATED (ESTABLISHED 1836)

pump division

13500 PHILMONT AVE., PHILADELPHIA 16, PENN.

Instrumentation

Begins on page 307

lers for measuring electrical and process variables are described in 12-p bulletin GEA-6887. General Electric Company

694 **Instrument and control** panels are detailed in 16-p booklet G71-7. Gives standard procedures for tubing and wiring. Bailey Meter Company

695 **Gas-flow control** equipment for argon, helium and CO_2 is topic of 12-p catalog 806A. Air Reduction Sales Company

696 **Water-treatment plant** control is discussed in 8-p bulletin W18.1-2. Covers problems faced by utility, methods of solving them. Bailey Meter Company

697 **Power-plant automatic controls** are described in 12-p bulletin E-88. The Cooper-Bessemer Corp

698 **Instrument, control switches** are topic of 8-p bulletin 14B8112B. Allis - Chalmers Manufacturing Company

699 **Controllers,** regulators, recorders—pneumatic and electric—are some instruments listed in 4-p catalog 358. Scientific Instrument Company

700 **Automatic controls** for engines and compressors are covered in 14-p bulletin 87. Application photos, diagrams give full details. The Cooper-Bessemer Corp

701 **Diesel-engine controls** are listed in informative 24-p bulletin B45-1. Includes photos, diagrams, complete specs. Minneapolis-Honeywell Regulator Company

702 **Industrial control line** is topic of 8-p bulletin 958. Individual products and assembled controllers are pictured. The Euclid Electric & Mfg Co

703 **Control panels,** centralized type for water conditioning and ion exchange, are topic of 12-p bulletin 4543. Pfaudler Permutit Inc, Permutit Co Div

704 **Electronic instruments** in indicating, recording, controlling models are detailed in 64-p bulletin P1245-A. One section describes incorporation into other makers' equipment. The Bristol Company

705 **Recording controllers,** recorders and indicators are described in 12-p bulletin GEA-6792. General Electric Company

706 **Temperature controls** and mounting wells are topic of 8-p booklet MC-177. Fenwal Incorporated

707 **Panel control systems** for automatic oil, gas or dual-fuel boiler burners are described in 4-p bul-

Engineering supervision insures Gilsulate's superior protection of underground hot pipes

From the standpoint of installation cost, thermal efficiency and service life, there is no better method of insulating and protecting underground hot pipes against corrosion, chemical and electrical attack than the use of GILSULATE.

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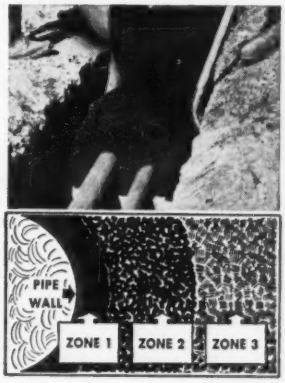
3. *Three Types Available:*

Type A for 220-300°F. temp. range
Type B for 300-385°F. temp. range
Type C for 385-520°F. temp. range



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*with this valve

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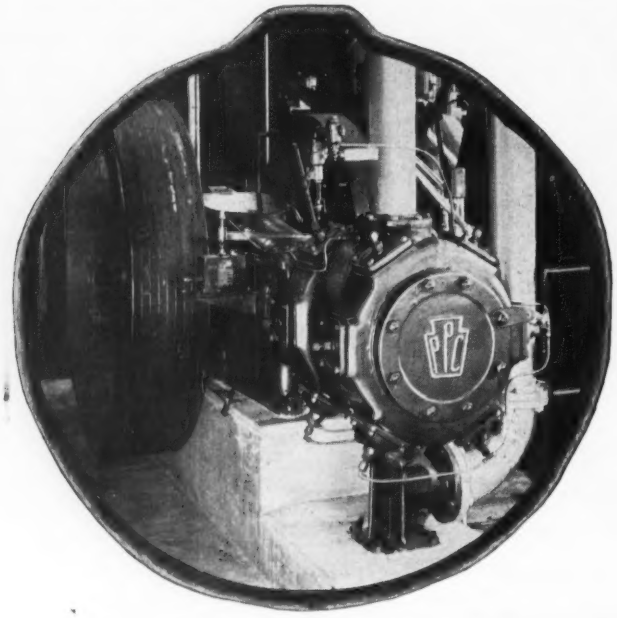

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*Reason: the Pennsylvania Air Cushion Valve, constructed without nuts, bolts or screws. Stainless steel valve discs lift against a soft cushion of air; there is no flexing or bending action to weaken them. They will remain perfectly seated over long periods of service.

The compressor above delivered over 20 years of continuous performance . . . three days were lost once when it was moved, but that's all. Isn't it time you were on the receiving end of this kind of sure, sustained performance? Write today for your free copy of "Compressors for Industry" which describes Pennsylvania Compressors from 10 to 350 hp.

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Instrumentation

Begins on page 307

letin 5803-A. Iron Fireman Manufacturing Company

708 **"Automatic controls** systems guide for architects and engineers" is an 8-p booklet, F-8944. Analyzes application, basic types, selection factors. Barber - Coleman Company

709 **Centralized control systems** are described in 16-p bulletin 106. Details design approach, materials, construction. Panellit, Inc

710 **Pneumatic** temperature controls are discussed in 4-p folder, with handy application pictures included. Partlow Corporation

711 **Temperature controllers** for industrial heating and cooling are described in 4-p spec sheet S1010-6. Minneapolis - Honeywell Regulator Co, Industrial Div

712 **Temperature detection** at low cost is subject of 30-p catalog 3036C. Accessories are described. McGraw - Edison Company, Instrument Div

713 **Steam-pressure regulator** is a complete automatic combustion-control system for packaged boilers. Bulletin E 102A gives full details. Reliance Instrument Manufacturing Corp

714 **Combustion-control system** application to four makes of pulverized-coal-fired boilers is described in 12-p bulletin 510. Bailey Meter Company

715 **Combustion-control** diagrams for chain-grate- and spreader-stoker-fired boilers are included in 4-p bulletin 515. Bailey Meter Co

716 **Thermocouples** and accessories are covered in 36-p catalog and convenient price list. Claud S Gordon Company

717 **Temperature - millivolt** thermocouple conversion tables make up a 4-p chart. Thermo Electric Co, Inc

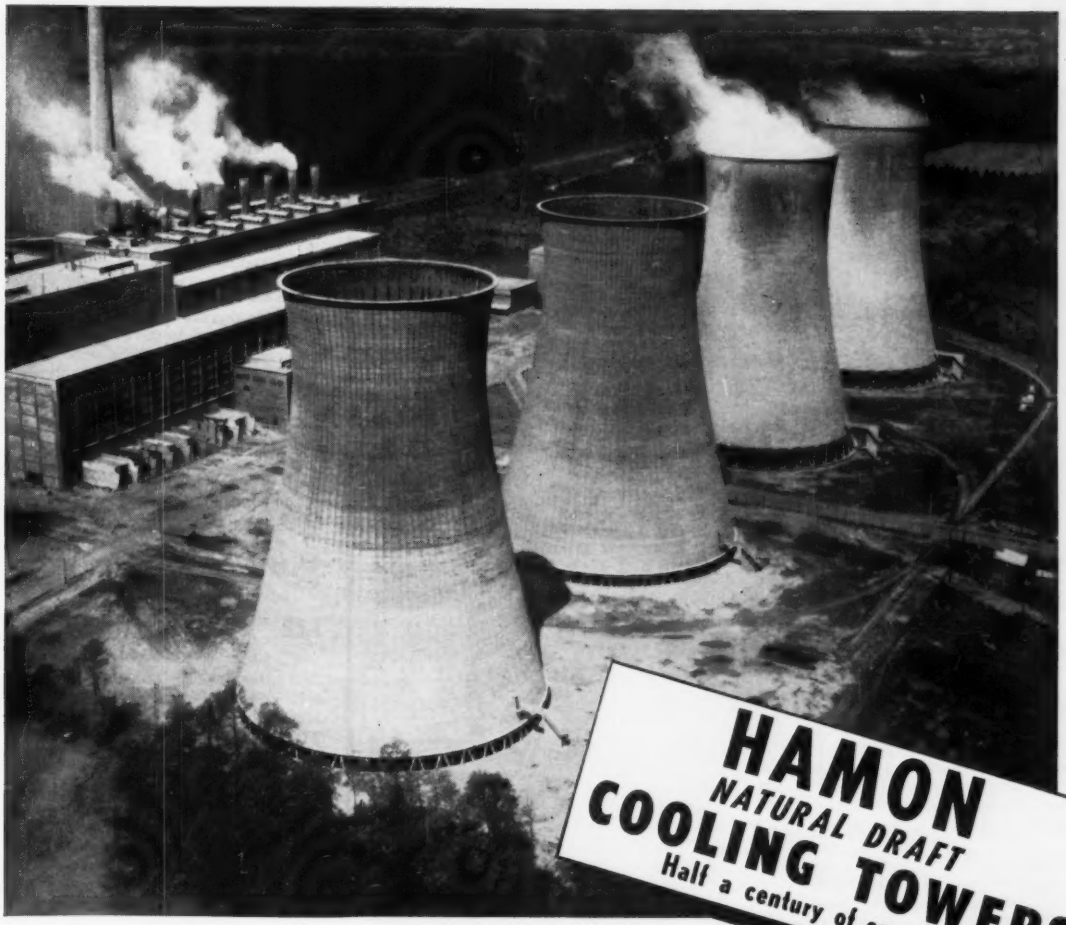
718 **Analyzers**—infrared, photometric, oxygen-trace, thermal-conductivity types—are described in informative new bulletin. Analytic Systems Company

719 **Continuous-stream analyzers** are subject of 8-p catalog CL-4000. Beckman/Scientific and Process Instruments Div

720 **Orsat gas analyzers** are topic of 12-p brochure 55-668-27. The Hays Corporation

721 **Automated system** for continuous chemical analysis is described in handy 8-p brochure. Technicon Controls, Inc

722 **Flow transducer** for single or bi-



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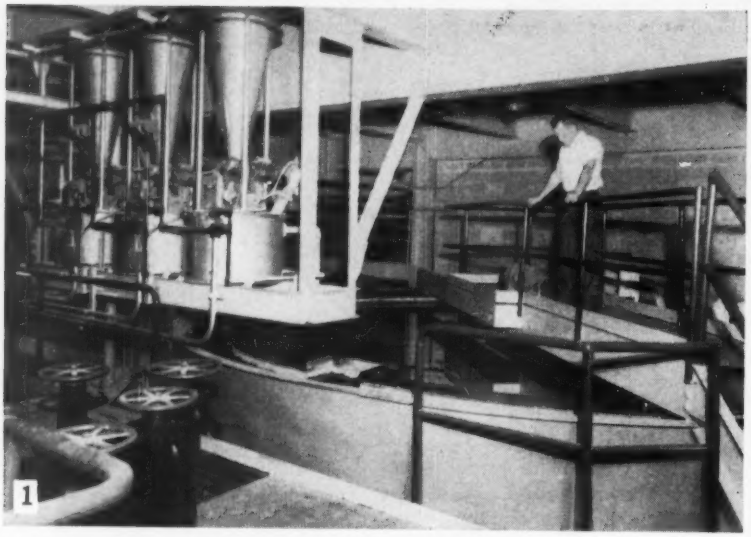
FLUIDICS* AT WORK



How new McMeekin Station treats its boiler water

Raw lake water from Lake Murray is the source for boiler feed at the new Silas C. McMeekin Station of South Carolina Electric and Gas Co.

Here's what the water analysis looks like:

Silica	9.0 ppm
Iron	0.8 ppm
Turbidity	15.0 ppm
Colorants	35.0 ppm
Electrolytes	50.0 ppm

Hardly the sort of water you put in a boiler operating at 2450 psig. So you'll find a complete Permutit water treatment system at McMeekin Station. Gilbert Associates, Inc., Reading, Pa., consultants on this job, report current results from the equipment as follows:

1. Precipitator and chemical feeders lower iron to 0.2 ppm, turbidity to less than 5 ppm, colorants to 2 ppm.

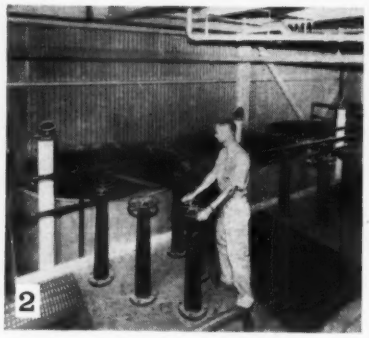
2. Three gravity filters further reduce turbidity to less than 1 ppm.

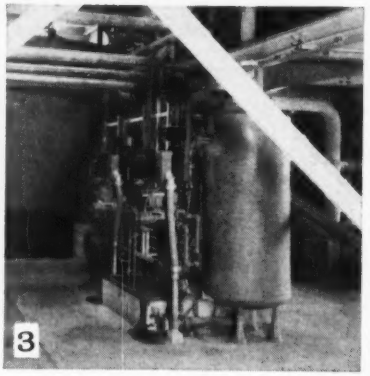
3. Complete demineralization plant, cation and anion exchangers lower the scale-forming silica to an inoffensive .02 ppm, electrolytes to .75 ppm.

4. Fully automatic Permutit control cubicle (not illustrated) remotely controls, monitors and records systems operation at all times.

Such complete water treatment is typical of a Permutit installation and of the all-round service you get from our FLUIDICS program. If you have a boiler feed water problem, for example, our Permutit Division can provide everything you require from initial survey to final equipment system.

For more information, write PERMUTIT, 50 West 44th Street, New York 36, N. Y., or call your local Permutit representative.





*FLUIDICS is a complete, imaginative Pfaudler Permutit program which economically provides practical answers to problems involving liquids and gases.

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Specialists in FLUIDICS...the science of fluid processes

directional flow is topic of 4-p brochure. Ramapo Instrument Company

723 **Liquid-level gages,** remote-reading models, are included in 8-p catalog 338. Features operation and application data. Jerguson Gage & Valve Company

724 **Flow-rate transmitters** are topic of 12-p bulletin 170. Includes capacity tables, helpful diagrams. Brooks Rotameter Company

725 **Gages and accessories** are listed in 38-p catalog AG-1. Gives cross sections, photos, cutaways. International Register Company

726 **Liquid-level** and flow control is topic of 24-p bulletin ERS-A. Shows how standard products are used to cure control headaches. McDonnell & Miller, Inc

727 **Resistance elements** handling temperatures to 1200 F, pressures to 4500 psig are described, illustrated in 4-p bulletin E51-6. Bailey Meter Company

728 **Safety gage case** for all h-p applications is feature of firm's pressure-gage line. Entire line is listed in 48-p catalog. Kunkle Valve Company

729 **Precision pressure gages** are detailed in 36-p booklet DH-65. Includes photos, tables, engineering info. American Chain & Cable Company, Inc, Helicoid Gage Div

730 **Test equipment**—volt-ohmmeters, refrigeration and air-conditioning testers—is discussed in 8-p catalog 2060. Simpson Electric Company

731 **Moving temperature probe** is topic of 4-p bulletin 1048. Unit patrols critical boiler gas passages and warns of incipient hot spots during lighting off. Blaw-Knox Company, Copes - Vulcan Div

732 **Process instruments** available for quick shipment are topic of 52-p catalog 2. Indicators, transmitters, recorders and controllers are among units listed. Fischer & Porter Co

733 **Draft** — what, where, how and why—is topic of 19-p bulletin 58-S201. Draft gages are also described in this informative booklet. The Hays Corporation

734 **Dall flow tubes** for metering water, other fluids are topic of 4-p bulletin 115-LIB. Builders-Providence, Inc

735 **Ultrasonics** and its uses is topic of 5-p reprint. Acoustica Associates, Inc

736 **Hydrostatic instrumentation** is topic of 88-p pocket-sized hand-

For more facts circle 958 on Reader Service card, p 227

Begins on page 307

book. Gives info on principles of hydrostatic measurement, selection and installation of instruments, design and construction of panel systems. Petrometer Corp

737 **Gas regulators,** cylinder, manifold and station-pressure types, are listed in 36-p catalog ADC 705F. Includes detailed flow and pressure specs, inlet and outlet connection dimensions. Air Reduction Sales Company

738 **Industrial controls** are detailed in 88-p catalog C101-1a. Five sections cover application and ratings info, electric controls, pneumatic controls, valves and accessory equipment. Includes photos, diagrams. Minneapolis-Honeywell Regulator Company

739 **Flowmeters**—recording, integrating, controlling units—are covered in 44-p catalog C20-1. Application photos help show details. Minneapolis - Honeywell Regulator Company

740 **Bellows flowmeter** is topic of 24-p booklet C22-1. Operation and construction, features, specs are covered. Includes diagrams, photos. Minneapolis-Honeywell Regulator Company

CONTROL VALVES

741 **High-velocity** valve attenuators are subject of 24-p bulletin K33-A. Provides graphs, diagrams, charts. Connor Engineering Corporation

742 **Pressure switches** are detailed in 36-p design handbook. Each page describes one type—diaphragm, bourdon tube or piston. Barksdale Valves

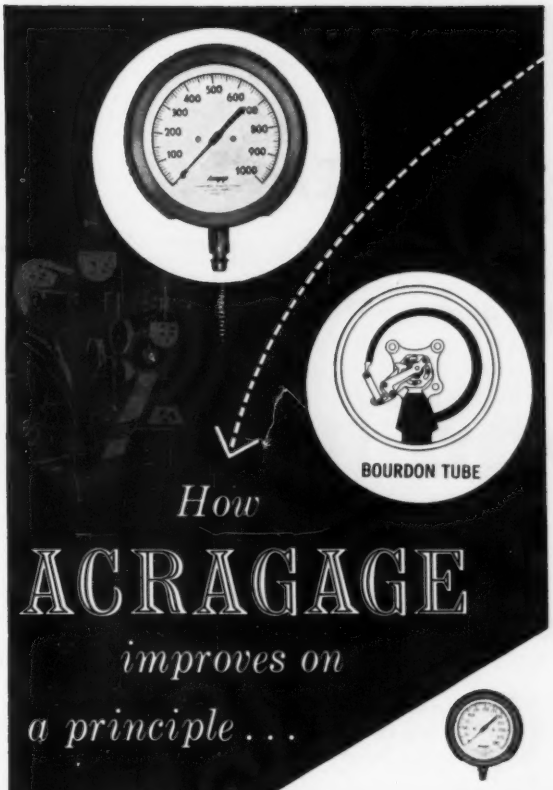
743 **Process control valves,** pneumatic, electric, hydraulic and manual, are studied in 88-p catalog C800-1. Drawings, cross sections and comprehensive tables give details; one part covers reference data. Minneapolis-Honeywell Regulator Company, Valve Div

744 **Diaphragm control valves** in sliding-gate and plate models are discussed in 8-p bulletin J-170. OPW-Jordan

745 **Sliding-gate** temperature-control valve is subject of 4-p folder J-180. OPW-Jordan

746 **Control valves** are covered in 12-p booklet LB-3. Gives construction, operating characteristics for 600-lb ASA-rating units. Conoflow Corporation

747 **Sliding-gate valve,** pilot-operated pressure-reducing type, is



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Acragage's reputation for high accuracy and dependability is a result of continuous research and development. The Bourdon Tube, ("heart" of Acragages) was patented over a hundred years ago. Acragage technicians, however, have always felt that if anything is good, research can make it better.

The result is a Bourdon Tube which is 10% to 15% longer than those in general use. Heavier walled tubing is used in its construction enabling the tube to operate well below its elastic limits. Sustained accuracy, increased repeatability, and greater over-pressure protection are provided with Acragage's longer Bourdon Tube. Acragage Bourdon Tubes are available in Phosphor Bronze, Alloy Steel, Stainless Steels, and Monel.

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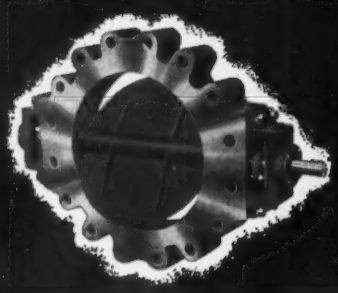
ARE YOU AWARE OF THE ADVANTAGES OF
BUTTERFLY VALVES?



FISHER-CONTINENTAL Butterfly Valves are low cost — more compact than expensive, complex valve installations. Simplicity of design makes them easy to service and maintain, easier to install and easier to operate.

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For gas, vapor, liquid or semi-solid control problems specify Fisher-Continental Butterfly Valves—any size . . . any metal or alloy . . . any temperature . . . any fluid . . . any pressure . . . any condition . . . any operator, manual or power.

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topic of informative 4-p bulletin J-1160. OPW-Jordan

748 **Motorized valve operator** for small globe and gate valves, new or installed, is covered in bulletin 21-58. R E Lovekin Corp

749 **Plug-valve actuators** are described in 22-p brochure. Details specs, dimensions and torque of the units. Pantex Manufacturing Corporation

750 **Solenoid control valves** with drip-tight closing are subject of 4-p folder 136. Cla-Val Co

751 **Valve-regulator** maintenance is discussed in 16-p manual 1099. Shows installations, mounting arrangements and piping. Rockwell Manufacturing Company, Meter & Valve Div

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Rampart Canyon Dam, projected massive hydro plant on the Yukon River, would create a reservoir so large it might warm interior Alaska. Alaska's Sen. Ernest Gruening urges an early start, since completion may take 13 years.

Coal industry must fight for vigorous survival, states Philip Sporn of National Coal Policy Conference. A healthy coal industry is vital to supply America's future energy demands.

"Better watch your step today. When the boss snaps them off like that, he's in a bad mood."

OTHER POWER SERVICES

LATEST EQUIPMENT: For more info on any of these items, circle key numbers on Reader Service card, p 227

278 **New polyurethane** plastic features high tensile strength at high ultimate elongation. *Estane VC* is reported to have excellent solvent resistance, low air permeability and outstanding abrasion resistance. First major application is expected in wire and cable jacketing and other uses might include fuel hose, tubing, belting, valve diaphragms.—B F Goodrich Chemical Co

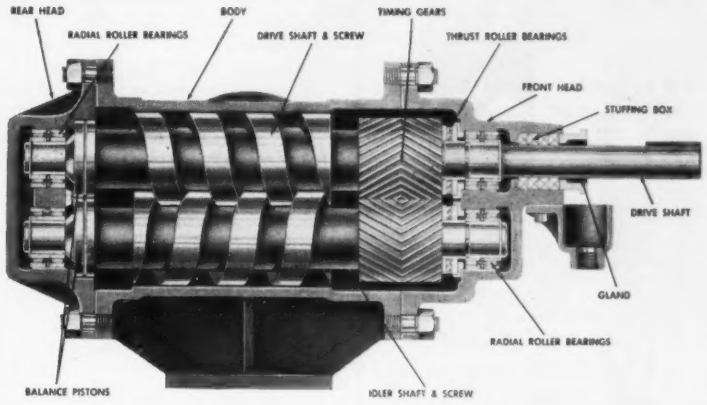
279 **Self-lubricating ribbon sealant** lastingly protects pipe joints against acids, gases and solvents. It's made of a chemically inert resin to prevent contamination. Use it at −450 to +500 F.—Anchor Packing Company

280 **Foaming chemical solvent** expands 20 times to make a low-cost lather for industrial cleaning. Where liquid chemicals are too heavy or create too much pressure for complex heat-exchange and process equipment, lightweight foam solvent completely fills every loop and bend of equipment and carries away dirt particles. The foam generator fits on a small truck.—The Dow Chemical Co, Dowell Div

281 **Manufactured graphite** is now produced in fiber and fabric form, promising greater scope for the already-versatile mineral. To properties of high- and low-temperature strength, acid and alkali resistance, electrical and thermal conductivity and self-lube, graphite's new flexibility adds the major advantage of immunity from thermal shock. Textile form might be used for refractory materials subject to thermal cycling, bag type filters for hot non-oxidizing gases, corrosive-fluid handling, electrostatic precipitators, flame arresters. As a resistance-heating element graphite cloth could be used to concentrate heat where it's wanted. Possible mechanical applications are valve packing, gasket materials for h-t seals, conveyor belting.—National Carbon Company

282 **Lightweight Geiger counter** is built around only two tubes. It

SIMPLICITY lowers the cost of this WARREN TWIN SCREW PUMP

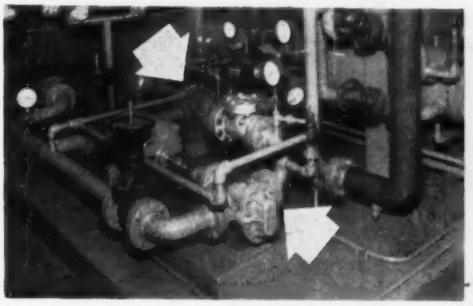


Here's an inside view of a high-speed screw pump that will do the work of other top quality rotary pumps costing twice as much!

Notice the simple construction of this Warren Twin Screw Pump, and the minimum number of parts. The compactness means low initial cost . . . and because no special foundation is needed, installation costs are minimized. No modification is required for vertical operation where floor space is extremely limited, or where the driver must be elevated to prevent flooding.

Maintenance of this efficient type TS pump is also economical. By removing the rear head only, rotating elements can be withdrawn *without disturbing the piping or motor*, and repair parts *that need no field machining* can be shipped immediately from stock.

Four sizes of type TS Screw Pumps are available for capacities to 550 GPM and discharge pressures to 350 PSI over a wide viscosity range. They are particularly suited for *fuel oil services* and other heavy duty oil services requiring a constant, pulseless flow. An ideal application is pictured below.



Two Warren Type 337TS Twin Screw Pumps on *fuel oil burner service* are shown in this installation at the Holyoke, Mass. Gas & Electric Department Plant.

WRITE FOR BULLETIN 255

for more detailed information about the TS Screw Pump that does the job for about one-half the cost.

WARREN

CENTRIFUGAL · SCREW · RECIPROCATING · ROTEX

WARREN PUMPS, INC.

WARREN, MASSACHUSETTS

P-37

For more facts circle 962 on Reader Service card, p 227

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Adjustable **SPROCKET RIM**
with Chain Guide
Changes that Danger Zone to a
SAFETY ZONE

The distance between the floor of your plant and your overhead valves is a DANGER ZONE when piled up boxes or even ladders are used to reach the valves.
Turn it into a SAFETY ZONE — equip your overhead valves with Babbitt Adjustable Sprocket Rims with Chain Guides.

- They simplify pipe layout.
- They fit any size valve wheel.
- They are easy to install and operate.
- They operate any valve from the floor.
- They save time and money.
- The first cost is the only cost (no maintenance).
- They are packed completely assembled (one to a carton), with easy-to-follow instructions.
- A hot-galvanized rust proof chain is available for all sizes.

Babbitt Adjustable Sprocket Rims with Chain Guide are carried in stock by most mill supply houses. If your supplier does not carry them, contact us direct.

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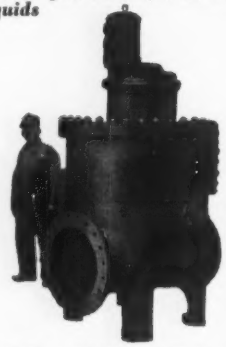
STRAINERS
. . . for efficient removal and disposal of suspended particles from raw or process water and other liquids



- Over 1000 installations
- 2" to 48" pipeline sizes
- Installation on pressure or suction side of pump

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Other power services

Begins on page 321

weighs 400 lb, is priced within reach of average labs. Use it for radiation measurement in labs and nuclear installations or for field work—engine wear studies, waste-material testing, monitoring atomic reactors.—Amperex Electronic Corporation, Special Tube Div

283 **Exotic materials** uniformly dispersed in a matrix alloy are furnished to exacting specs of grain size, concentration. Custom combinations such as boron-carbide, dysprosium-oxide, zirconium-oxide dispersions in matrices like aluminum, nickel, tin are available.—Sintercast Corporation of America

NEW DESIGN AIDS: for your free copies, just circle the key number on Reader Service card provided on p 227

752 **Engineering scale models** for piping and structure design are described in two bulletins. Industrial Models, Inc

753 **Tables and formulas** for electrical data and materials properties, heat-transfer and steam info are included in 120-p pocket-sized booklet B-3677D. Westinghouse Electric Corporation

754 **Metal-filled epoxy cement** use is topic of 4-p bulletin. Illustrations show various applications for the cement. Smooth-on Manufacturing Company

755 **Fire-fighting** equipment is described and illustrated in 16-p brochure. Chart of types of extinguishers used is included. Walter Kidde & Company, Inc

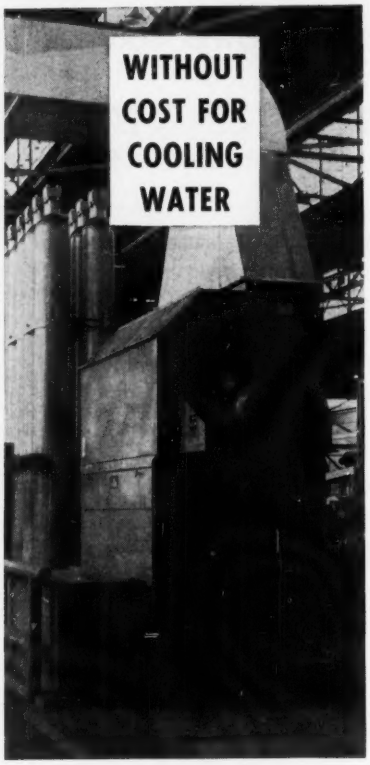
756 **Radiation-resistant fluids,** polyphenyl compounds and their alkyl derivatives, are listed in 4-p booklet. Monsanto Chemical Company

757 **Polyurethane elastomer** is described in a 24-p booklet. Graphs, charts and photos cover physical, chemical, electrical, thermal data. Disogrin Industries, Inc

758 **Engineering properties** of austenitic ductile irons is topic of 28-p booklet. Tables and graphs explain physical properties, erosion and corrosion resistance. The International Nickel Co, Inc

759 **Wrought-iron use** in process field is topic of 4-p reprint. A M Byers Company

760 **Galvanized steel sheets** are topic of 36-p booklet. Properties, in-



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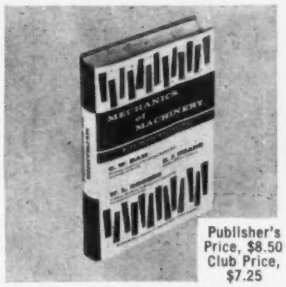

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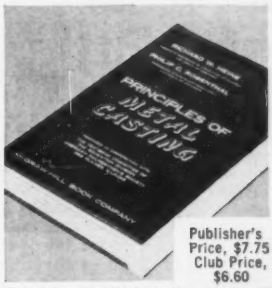
Mechanics of Machinery by C. W. Ham, E. J. Crane, and W. L. Rogers. Fourth Edition. Methods, data, and theory in all major areas of mechanics.



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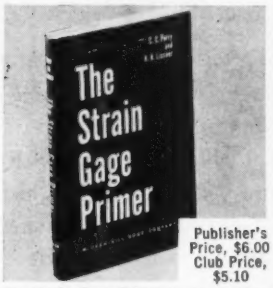
Mechanical Design for Electronics Production by J. M. Carroll. How to design and manufacture durable electronic equipment.



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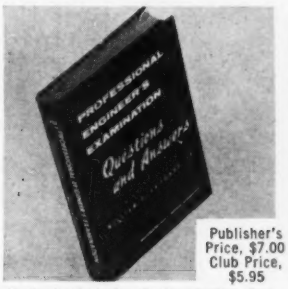

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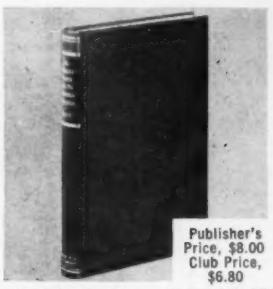

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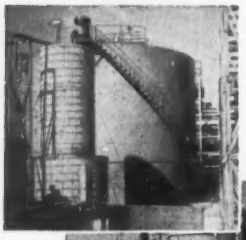

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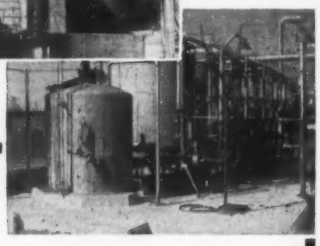

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Other power services

Begins on page 321

dustrial applications, purchase and maintenance are discussed, comprehensive specs included. American Zinc Institute, Inc

761 **Wrought-iron alloy** containing manganese is described in 8-p booklet—includes working properties, corrosion data. A M Byers Company

762 **"Nuclear fuels:** Key to reactor performance" is title of 24-p booklet. Design aspects, fuel cycle, typical reactors and firm's services are covered. Sylvania-Corning Nuclear Corp

763 **Fire extinguishers,** dry chemical type, are described in 4-p brochure P-48. Walter Kidde & Company, Inc

764 **Fire-extinguishing systems,** portable extinguishers, cabinets and other inside fire-control products are detailed in 28-p brochure S-62. Includes specs, operation descriptions, installation diagrams. The Fyr-Fyter Company

765 **Fire-extinguisher guide** is a 6-p folder. Table compares characteristics of various types of fire extinguishers; graph compares agents. Ansul Chemical Company, Fire Equipment Div

766 **"Fabrication of Plexiglas"** is title of 34-p "how to" handbook. Includes hints on cleaning and maintenance, sources of supplies. Commercial Plastics & Supply Corp

767 **Sound traps** to silence air-system and duct noises are described in 4-p bulletin. Koppers Company, Inc

768 **Emergency** and maintenance repairs with "plastic steel" are listed in 8-p bulletin 3. Devcon Corp

769 **Automatic** tube-expander drives are covered in 6-p bulletin 581. Includes an easy-reference chart. Thomas C Wilson, Inc

770 **Silicone** applications are covered in 16-p guide. Graphic examples show how to use over 150 products available. Dow Corning Corp

771 **Nuclear-power plants** as part of electric-utility systems are discussed in 18-p brochure. Nuclear Science and Engineering Corp

772 **Solid-polyurethane** applications are described in an 8-p technical reprint. Uses include pump stators, LOX containers, seals. Disogrin Industries, Inc

773 **Aluminum use** in electrical-power generating stations is theme of 34-p brochure. Applications range from bus conductors, siding, ducts, to stair treads, condenser tubes. Aluminum Company of America

continued

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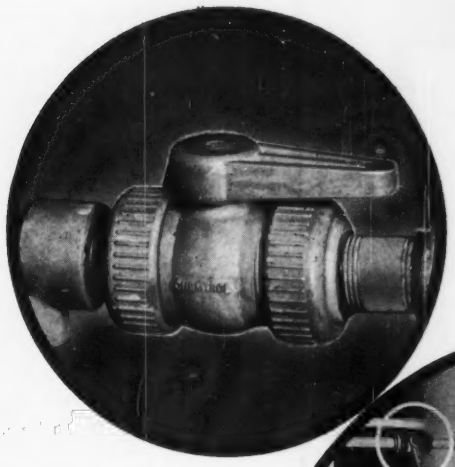
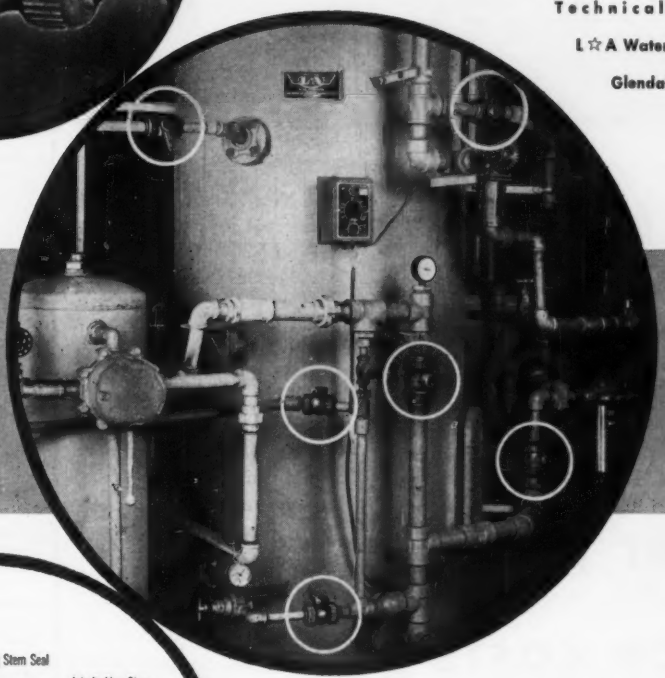
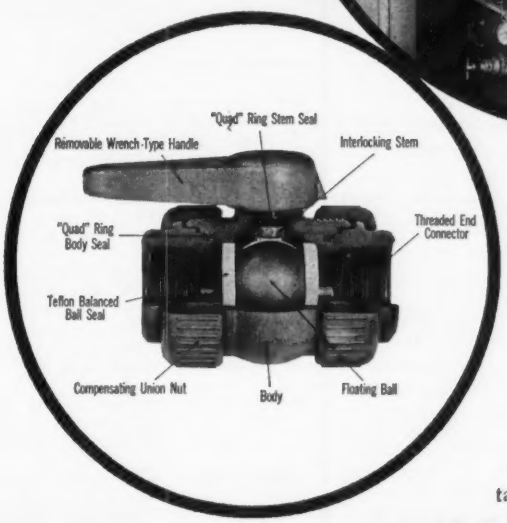




CHEMTROL plastic ball valves, part of original equipment, on deionizing system at Pioneer Electronics, Los Angeles. Firm rebuilds TV picture tubes. Water purity is essential in preventing screen discoloration.



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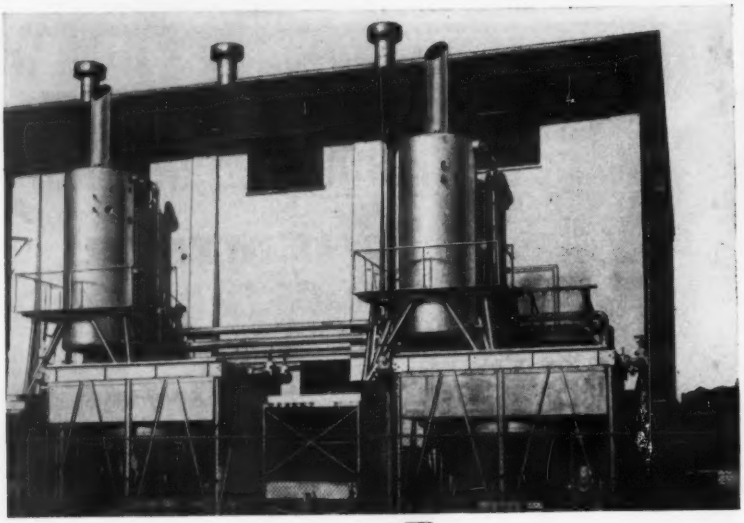

MAXIM silencers help Florida power plant reduce costs

The New Smyrna Beach municipal power plant has two new 2500 HP Enterprise Turbocharged Diesels. They burn heavy, low-cost residual fuel at a considerable saving. However, this fuel requires pre-heating. Maxim Heat Recovery Silencers efficiently capture waste heat from the diesel exhausts and pre-heat the fuel—at virtually no operating cost.

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Other power services

Begins on page 321

774 **Types of fires** are listed on large wall chart. Illustrates three classes of fires, extinguishers for each. Walter Kidde & Co, Inc

775 **Mixers and mixing** are subject of bulletin 730. Infilco Inc

EDITOR'S NOTE: *The following new bulletins may be requested directly from the manufacturer. Write on your company letterhead to addresses listed below.*

Condenser handbook has 32 pp, gives simple methods of calculating steam-condenser performance. Curves, charts make up most of book. C H Wheeler Manufacturing Company, 19th & Lehigh Ave, Philadelphia 32, Pa.

Mechanical-draft and other heavy-duty fans are described in 28-p bulletin FD-905. Includes selection data, performance tables, design sketches. Buffalo Forge Company, Buffalo 5, N. Y.

Air-conditioning zone-control cabinets are described and illustrated in 20-p bulletin AC-220. Tables, curves and sketches cover selection, ratings. Buffalo Forge Company, Buffalo 5, N. Y.

Refractories are covered in set of three 4-p bulletins. Firebrick cement, plastic firebrick, castables are covered. Botfield Refractories Company, Swanson & Clymer St, Philadelphia 47, Pa.

Facilities brochure describes firm's power-plant, pump, marine and nuclear-components divisions. C H Wheeler Manufacturing Company, 19th & Lehigh Ave, Philadelphia 32, Pa.

Tracing templates for mechanical system development are offered in free package. Gears, dials, cams, shafts, couplings are some of components covered. PIC Design Corporation, 477 Atlantic Ave, East Rockaway, L. I., N.Y.

Precision welding equipment is covered in 4-p catalog. Vacuum Tube Products Co, 2020 Short St, Oceanside, Calif.

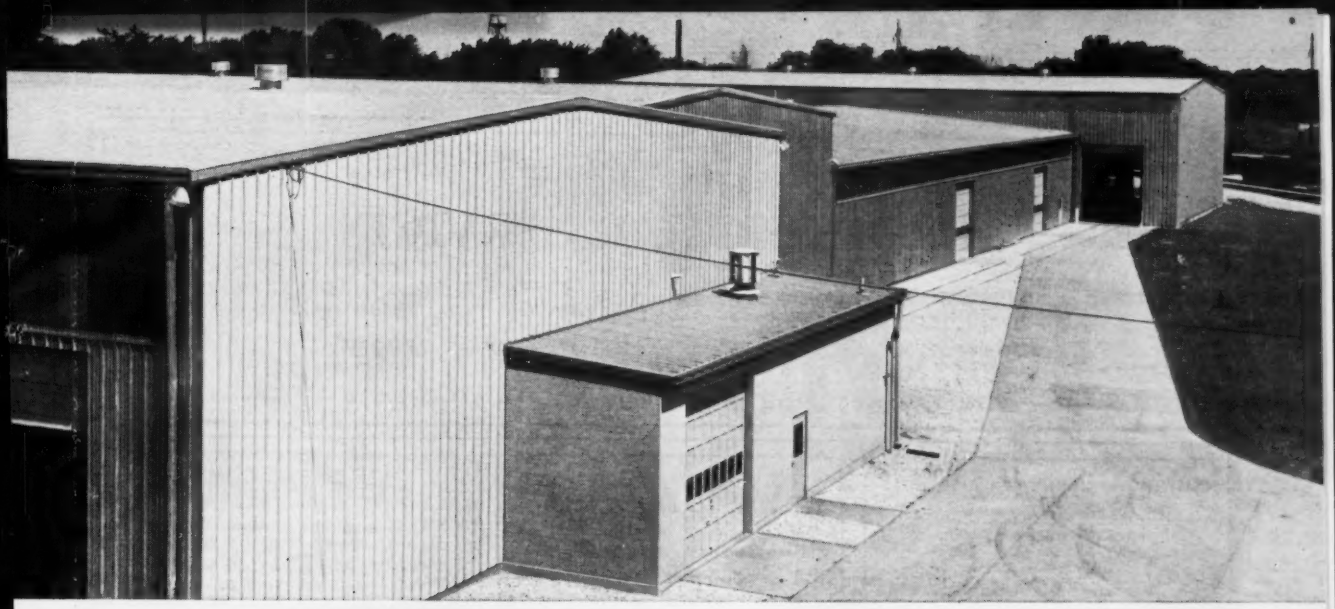
Industrial nozzles are detailed in 32-p catalog 59. Info on spray angles, dimensions, types of connections for standard nozzles is presented. Wm Steinen Mfg Co, Industrial Nozzle Div, 45 Bruen St, Newark 5, N. J.

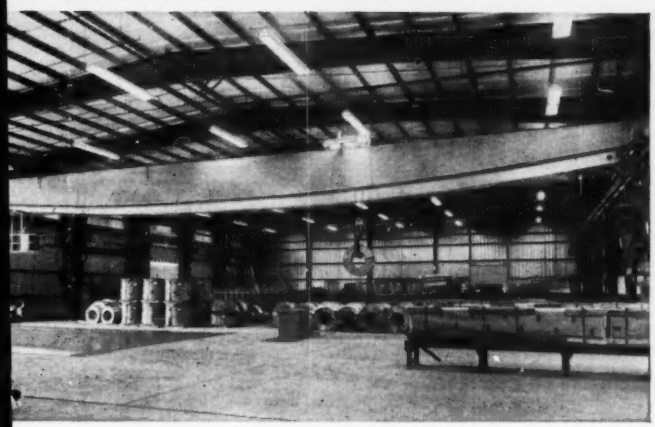
Couplings and fittings for all types of industrial rubber hose are subject of 8-p bulletin 34. Hose Accessories Co

ASME Boiler Code guide illustrates some types of pressure-vessel construction. Missouri Boiler and Tank Company, 23rd & Papin St, St. Louis 3, Mo.

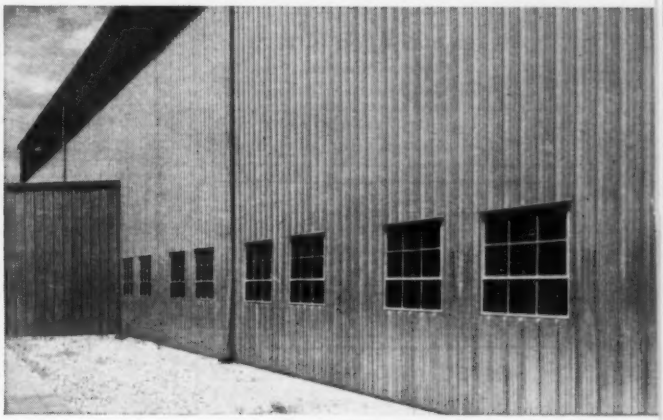
Carbon, graphite properties and uses are covered in 56-p manual. Gives mechanical, electrical, refractory application info. Stackpole Carbon Company, St. Mary's, Pa.

Cams, camshafts and crankshafts are covered in 12-p bulletin 39. Meehanite Metal Corporation, 714 North Ave, New Rochelle, N. Y.





Spacious, clear-span interiors



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1500 KW MOTOR GENERATOR SETS

These identical units have 1500 KW gens. producing 6000 amps @ 250V DC. The motors are Westinghouse 2140HP, synchronous, 514 RPM, 3/60/4600V, self excited. Complete with starting compensator, oil circuit breakers & DC panel. New in 1934 and have been maintained in EXCELLENT condition.

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3500-7500 KW, 2300/4160 V - 3/60
400 psi @ 600F Condensing

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1 Condensing Turbine — Westinghouse 1000 KW 3/60 2300V 3600 RPM 160 PSIG, complete with circulating pumps and auxiliaries.

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HP	Make	Type	Speed
500	L.A. B.B. Splash 440 Volt	FX-1469	3600
500	G.E. S.B. Open	IK	1200
400	G.E. S.B. Open	IK-178	900
400	L.A. B.B. Splash		1800
400	G.E. S.B. Open	IK	1200
400	West. S.B. Open	CS	900
400	West. S.B. Splash 2800 Volt	CS-898	720
300	G.E. S.B. Open	IK	600
300	G.E. S.B. Open	IK	1800
300	G E. S.B. Open	IK	900
300	G.E. S.B. Open	IK	720
300	West. S.B. Open	CS-1002	600
250	El. Dyn.	KNX	1800
	T.E.F.C.B.B.		
250	G.E. S.B. Open	KT	1800
250	West B.B. Splash	CS-875	1800
250	G.E. S.B. Open 2200 Volt	IK-16	1200
250	G.E. S.B. Open	IK	1200
250	G.E. S.B. Open	IK	900
250	G.E. S.B. Open	IK	720
200	West S.B. Open	CS	1200
200	G.E. S.B. Open	IK-15	1200
200	G.E. S.B. Open	IK-155	1200
200	G.E. S.B. Open 2200 v.	IK	1200
200	G.E. S.B. Open	IK	900
150	L.A. TEFCBB	IX-114	3600
150	G.E. S.B. Drip	K-6324	1800
150	West. S.S.B. Open	CS-771.1	1800
150	West. S.S.B. Open	CS-761C	1800
150	Al. Chal. B.B. Open	AR	1800
150	West. S.B. Open 2200V	CS	1800
150	G.E. S.B. Open	IK	1800
150	G.E. S.B. Open	KT	1200
150	F.M. B.B. Open	H-24A	900
150	G.E. S.B. Open	IK	900
150	Cant T.E.F.C. B.B.	New	900
150	G.E. S.B. Open	KT-558	900
150	G.E. S.B. Open	IK	720
125	G.E. TEFCBB	K	3600
125	Burke B.B. Open 440 Volt	N-505	3600
125	Cont. TEFCBB XP	AP-109	1800
125	G.E. S.B. Open	IK	1800
125	West S.S.B. Open	CS	1800
125	Al. Chal. B.B. Open	AR	1800
125	West TEFCSBCS	855	1200
125	G.E. S.B. Open	KT-553	1200
125	G.E. S.B. Open	IK	1200
125	G.E.B.B. Open	K-546	1200
125	F.M. B.B. Open	H	900
125	G.E. S.B. Open	IK	720
125	G.E S.B. Open	IK	600
100	Howell T.E.F.C.B.B.	K-505	3600
100	Cont. TEFCBB XP	AP-505	1800
100	West. T.E.F.C. B.B.	CS-753	1800
100	G.E. S.B. Open	KT-343	1800
100	G.E. B.B. Open	K-504	1800
100	L.A. TEFCBB	JX-113	1800
100	West. TEFCBB	CS-770	1200
100	G.E. S.B. Open	KT-347	1200
100	West SSB Open	CS-607	1200
100	F.M. R.B. Open	H20C	900
100	F.M. B.B. Open	H	720
100	F.M.B.B. Open	H	600
75	Reliance B.B. Splash	505	1200
75	Al. Chal. TEFCBB	ARZ	1200
75	F.M. B.B. Open	H	900
75	F.M. B.B. Open	H	600

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POWER EQUIPMENT

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3—1296 HP B&W Sectional Steel Headers 275 PSI Gas/Oil Fired
1—75000#/hr 650 PSI 650°F Oil Fired C.E.
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12—NEW UNASSEMBLED B&W, F.W. C.E. with Superheater, Economizer, Soot Blowers, Oil Burners, Steel Encased—Rated:
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44,500#/hr, 450 PSI, 735°F
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GENERATOR SETS

11—1250 KVA Natural Gas Engine Sets 3/60/2400/4160 with switch gear *(can be seen running)*
1—1875 KVA Condensing 400 PSI 700°F with Surface Condenser 3/60/2300 Turbo Set
1—500 KW Condensing 200 PSI Turbine
1—500 KW G.E. Non Condensing 265 PSI, 0-10# BP Turbo Generator

TRANSFORMERS

1—6000 KVA 3/60/44,000—4160 Substation
2—1500 KVA 3/60/34,500—460
1— 750 KVA 3/60/2400/4160 Y—480
3— 333 KVA 1/60/2400/4160 Y—480
3— 250 KVA 1/60/2400/4160 Y—480
3— 75 KVA 4600-115/230 Single phase
2— 50 KVA 440-120/240 Single phase

A. C. MOTORS — 3 ph. 60 Cy.

SQUIRREL CAGE 2300 Volt

Qu.	HP	Make	Type	Speed
2	2000	A.C.	ANW	1750
2	350	A.C.	AZZ TEFC X.P.	3600
1	250	Cont.	NP TEFC X.P.	720
1	200	G.E.	KF TEFC X.P.	3600
2	15u	G.E.	K TEFC X.P.	900*
1	150	A.C.	AZZ TEFC X.P.	3600
1	150	Cont.	PV TEFC X.P.	1800
1	125	Cont.	NP TEFC X.P.	3600
1	125	G.E.	KF TEFC X.P.	1800
3	100	G.E.	K TEFC X.P.	1800*
2	100	G.E.	KF TEFC X.P.	1800*
1	100	A.C.	AZZ TEFC X.P.	3600
1	50	G.E.	K TEFC X.P.	1800/900*

*440 Volt

SLIP RING 440 Volt

2	400	West.	CW	720
1	150	West.	CW	1800
3	75	West.	CW	1800
3	30	West.	CW	1200

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1250 K.W. TURBO GENERATORS

NEW — UNUSED

Mfg. by Westinghouse

GENERATOR:

1250 K.W.—450 volts—3 phase—60 cycle—80% P.F.—1200 R.P.M. with 16 K.W. on a 120 volt D.C. exciter.

TURBINE

540 lbs. per sq. inch gauge with 825° T.T. and one lb. per sq. inch absolute exhaust pressure. It will develop rated capacity with steam conditions of 432 lbs. per sq. inch—825° T.T. and one lb. per sq. inch exhaust pressure. Turbine R.P.M. 8050. The turbine exhausts into an auxiliary condenser.

DIMENSIONS

16'4 5/16" long—60" wide

These units originally built for Battleship Kentucky to highest Naval standards using only prime materials.

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ELIGIN 5-5050 — LEXINGTON 9-1900

TRANSFORMERS

1—6000 kva G.E. 3/66000/2400/4160Y
1—2000 kva Nia. Askarel, 3/13800/4160Y/2400
3—1000 kva Westinghouse, 1/22900/480
3—1000 kva Westinghouse, 1/13800/480
3—1000 kva Westinghouse, 1/13800/2400/4160Y
3—1000 kva Standard, 1/44000/6900
3—1000 kva Standard, 1/69000/4160Y/2400
3—1000 kva Standard, 1/34400/480
3—200 kva Westinghouse, 4800—240x480
3— 100 kva G.E., 2400/4160Y—120x240
3— 75 kva G.E., 2400/4160Y—120x240

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2—50,000# C-E boilers, 250 psi, coal and oil fired, 1948
1—60,000# Riley, 290 psi, 550 degrees, pulverized coal and oil fired. Cinder collectors, ash dispoasal system, Bailey controls and feed water pumps are included. 1947
1—110,000# C-E, 675 psi complete. Oil fired, 1941
1—200,000# B&W, 925 psi, 830 psi, coal and oil fired, 1944.

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2—600 GPM Gould, 8 stage, 2310' head, with 500 HP Westinghouse CSP-583H, 3550 RPM, 440 Volt Squirrel Cage motors and enclosed class 11-600 reduced voltage starters with disconnects.

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PUMPS

10 MAIN FEED PUMPS

PUMP: Ingersoll-Rand — size 5" — three stage — capacity 500 GPM @ 750# discharge pressure. B.H.P 330 — 5000 RPM. *TURBINE:* Worthington-Moore — design pressure 575#/sq. inch — non-condensing — back pressure 20# — 5000 RPM — 330 B.H.P.

GEARED TURBINE-DRIVEN MAIN FEED BOOSTER PUMPS

PUMP: Mfg. by Buffalo Pump Co. — vertical single stage — capacity 550 GPM — 30# discharge — 8" suction — 5" discharge. *TURBINE:* 1 stage impulse — type Y-W — vertical — design steam pressure 575# — back pressure 20# — 12.5 HP — 5500/1750 RPM — mfg by Terry Steam Turbine Co.

2 MAIN FEED BOOSTER PUMPS

Same as geared turbine driven main feed booster pumps above, but with 14.5 HP 440/3/60 AC Star motor & Ward Leonard control. Across-the-line starter with pushbutton.

8 GEARED TURBINE-DRIVEN VERTICAL CONDENSATE PUMPS

PUMP: Main condensate 2-stage vertical pump — mfg by Buffalo Pump Co. *Capacity:* 375 GPM — 70#/sq. inch discharge pressure — 1150 RPM — 22.5 BHP — 9" suction — 4" discharge. *TURBINE:* Single stage — 575# working pressure — 20#/sq. inch back pressure — 22.5 HP — 5360/1150 RPM — Mfg. by Terry Turbine Co.

2 AUX. FEED BOOSTER PUMPS

PUMP: Vertical — mfg by Buffalo Pump Co. — 200 GPM — 30# discharge pressure. *MOTOR:* 7.36 HP — 1800 RPM — 440/3/60 — Star motor, with control.

BRONZE RECIPROCATING STANDBY FEED PUMPS

11 x 8 x 18 — mfg by M. T. Davidson Co. — vertical simplex — capacity 180 GPM — 800/900# discharge pressure — 575# working pressure.

4 TURBINE-DRIVEN FIRE AND FLUSHING SERVICE PUMPS

PUMP: Worthington — horizontal centrifugal. *Fire Service:* 750 GPM capacity — 150 PSI discharge pressure — 3500 RPM. *TURBINE:* single impulse — type B-20 — mfg by B. F. Sturtevant — design steam pressure 575# per sq. inch non-condensing. Back pressure 15# — B.H.P. 80/90.

3 GEARED TURBINE-DRIVEN MAIN CIRCULATING PUMPS

PUMP: Mfg. by Worthington Pump & Machinery Co. — 28" type — vertical single stage — bronze. *Capacity:* 28,000 GPM — discharge pressure 13.5# — 600 RPM — 267 BHP — 28" suction — 28" discharge — 8.5:1 gear ratio. *TURBINE:* single impulse — vertical type — 575# design steam pressure non-condensing — back pressure 15#/sq. inch. RPM 5100 pinion — 600 gear. Reduction gear ratio 8.5:1 — 267 BHP — mfg by B. F. Sturtevant.

3 MOTOR DRIVEN MAIN CONDENSATE PUMPS

Mfg. by Buffalo Pump Co. — vertical 2-stage — 375 GPM — 70#/sq. inch discharge pressure — 1150 RPM. *Motor Data:* 25 HP — 440/3/60 — 1150 RPM — Star Electric Motor Co. — with across-the-line starter, with pushbutton station — mfg by Ward Leonard.

8 GEARED TURBINE-DRIVEN MAIN LUBE OIL PUMPS

Mfg. by Northern Pump Co. *PUMP:* Vertical rotary type — 750 GPM — 55#/sq. inch discharge pressure — 263 RPM — 35 BHP — oil viscosity 130 to 500 S.S.U. — 7" suction — 6" discharge. *TURBINE:* Single stage — 575# design pressure non-condensing — exhaust pressure 15# — 35 BHP — 26.39:1 gear ratio — 6940 RPM.

4 TURBINE-DRIVEN GEARED FUEL OIL BOOSTER PUMPS

Mfg. by Northern Pump Co. — vertical rotary — 300 GPM — 150# discharge pressure — 282 RPM — 47.3 BHP — Oil viscosity 70-700 S.S.U. — 7" suction — 5" discharge. *DRIVE:* single stage impulse — 575# non-condensing — 15#/sq. inch discharge pressure.

6 FUEL OIL SERVICE PUMPS

Mfg. by Northern Pump Co. — vertical rotary — 85 GPM — 350# discharge pressure — 560 RPM — 27.4 BHP. *TURBINE:* 1 stage — 575# non-condensing — exhaust pressure 15# — mfg. by Northern.

VALVES

THESE ARE JUST A FEW OF THE MANY VALVES OFFERED. ALL TYPES ARE AVAILABLE INCLUDING REDUCING—SENTINEL—RELIEF—MICROMETER — PRESSURE REGULATING — ANGLE, ETC! STEEL—600# SERVICE—SEND US YOUR REQUIREMENTS FOR QUOTATIONS

LESLIE 2" GOVERNOR VALVES

Type C.P. — class A — capacity 7640#/hr. — 575# steam pressure — 750# discharge pressure.

MOTOR OPERATED GATE VALVES

Low Pressure — comp. geared — 38" — mfg by Chapman Valve Co. *MOTOR DATA:* H.P. 18 ft. lbs. running torque — 45 ft. lbs. max. starting torque — 440 volts 900 RPM 3 phase 60 cycle. Type: Submersible Valve Brake — Motor: Star Electric Co.
Also available, same as listed, but 36", and 28" inch as listed, but with smaller motor.

MISCELLANEOUS

18 WIDE-RANGE FORCED DRAFT TURBINE-DRIVEN BLOWERS

9 R.H. — 9 L.H. — mfg by B. F. Sturtevant — propeller fan type — capacity 29,500 CFM/5540 RPM/250 BHP — 8250# steam/hr. — and, 9,000 CFM/1985 RPM/9 BHP — 690# steam/hr. — 7 blades — static: max 35" water — normal 21.5" water. Driven by Sturtevant turbine type VC-7 — non-condensing — single stage — 250 HP — 575# steam pressure — 15# PSIG exhaust pressure.

1250 K.W. WESTINGHOUSE TURBO-GENERATORS

(4) — Westinghouse—440/3/60 — 850° — 540 lbs. working pressure. Complete with condensers, circulating pumps, etc.

LUBE OIL COOLERS

4 — mfg by Westinghouse. 1600 sq. ft. cooling surface — cylindrical straight-tube horizontal type. Oil capacity 590 GPM — water capacity 1500 GPM — temp. oil inlet 150°F — outlet 120°F — temp. water inlet — 85°F — outlet 90°F. Number of ⅝" tubes 816 — Wall 0.049 TK — Cupro-Nickel.

MAIN CONDENSERS

Mfg. by Foster-Wheeler — 23,500 sq. ft. cooling surface — 40,500 GPM circulating water — total tubes 8,976, of cupro-nickel, as follows: (550) each ⅜" x 0.066 and (8416) each ⅝" x 0.049. Monel water boxes.

BOILERS

7 B&W EXPRESS TYPE

Design pressure 634# — operating pressure 565# — temp. 850°F. Oil fired — separately fired superheaters. *Capacity:* 210,000 lb. steam/hr. Ideal for testing where large quantities of steam are required, giving excellent control from separately fired superheaters.

3 GLAND EXHAUST CONDENSERS

Foster-Wheeler — total capacity lbs./hr.: 1200 lbs. steam and 350 lbs. air — 155 sq. ft. — 4" ejector.

LARGE DEAERATING FEED HEATERS

Monel construction — spray type — capacity 480,000 lbs./hr. — vent condenser — single pass — heating surface 174 sq. ft. — all Monel construction.

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WILL SELL SEPARATELY FOR TESTING, WIND TUNNEL OR SIMILAR WORK. *(2) High pressure* — 24,400 HP — 12 impulse stages — 4909 RPM — working pressure 540# — 825°F. *(2) Low Pressure:* 28,600 HP — 3913 RPM — working pressure 49# steam — 424°F — 2-6 stages of impulse.

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Thousands of new and "Certified Rebuilt" Motors & Generators in stock—up to 1000 H.P. OUR 53rd YEAR

A. C. MOTORS—60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	Whse. (2)	Sq. Cage	2300	1800
750	G.E.	Slipring	2300	514
700	Whse.	Slipring	2300/4000	1200
600	G.E.	Synch.	480	900
600	Elliott (2)	Sq. Cage	2300	900
500	Whse.	Sq. Cage	2300/440	1200
500	Allis Ch.	Slipring	2300/440	600
400	G.E.	Sq. Cage	440	1200
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2200	3600
400	G.E.	Slipring	2300	514
400	El. Machy.	Synch.	2300/4000	400
350	Br. Boveri b.b.	Sq. Cage	4800/480	720
350	G.E.	Sq. Cage	2200	1800
350	G.E.	Slipring	440	1200
350	Allis Ch.	Slipring	2200/4000	600
350	G.E.	Slipring	220/440	900
300	Whse.	Synch.	440	1200
250	G.E.	Sq. Cage	2200/440	1200
250	G.E.	Sq. Cage	2200/440	450
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E. TEFC	Sq. Cage	440	1200
250	Whse.	Sq. Cage	2300/440	600
250	Whse. (4)	Slipring	2300/440	600
200	G.E. b.b.	Sq. Cage	220/440	720
200	G.E.	Slipring	220/440	450
200	G.E.	Slipring	440	600
200	G.E.	Slipring	2200	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	2200/440	720
200	Whse.	Sq. Cage	2200/440	900
150	Whse. XP	Sq. Cage	440	3600
150	G.E. (4)	Slipring	2200/440	600
150	Cr. Wheeler	Sq. Cage	0/440	450
150	G.E. (2)	Sq. Cage	2200/440	1800
150	Whse.	Slipring	220/440	1200
150	G.E.	Sq. Cage	2300	900
125	El. Machy. (2)	Synch.	220/440	400
125	G.E. TEFC.	Sq. Cage	2200	3600
125	Al. Ch. TEFC	Sq. Cage	220/440	600
100	Whse. (2)	Sq. Cage	2200/440	720
100	Whse. TEFC	Sq. Cage	220/440	1200
75	G.E. b.b. (8)	Sq. Cage	220/440	1200

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	Gen. Elec.	RC	250	1450
150	Cr. Wh.	CCD	250	650
75	Allis Ch. b.b.	EB-146L	125	1500
75	G.E. b.b.	CD	250	1750
60	Ideal	D	125	1150
60	G.E. b.b.	CD	600	1750
40	Reliance b.b.	230-T	250	1200

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
250	Cr. Wh.	101-H	230	1150
200	G.E. (2)	RC-38	230	1150
200	Whse. b.b.	SK	250	287/575
150	Rel. TEFC b.b.	2550-F	230	850
150	Whse.	SK-210	230	320/1000
125	G.E.	CD-173	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
80	Whse. dyn. b.b.	SK-123L	250	1800/5000
75	Whse. (3)	SK-160	230	550/1150
75/100	Whse.	SK-191	230	300/900
60	G.E. TEFC b.b.	CD-135	230	1150
50	G.E. drip b.b.	CD-1445	230	300/1200
50	G.E.	RF-16	230	250/1000
30	Whse. b.b.	SK-133	230	400/1600
25	Whse. (2)	SK-153	230	300/1200

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	440 AC	250 DC
300	Whse. (2)	2200/440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
125	Whse.	220/440 AC	250 DC
100	Gen. Elec.	220/440 AC	250 DC
75	G.E. b.b.	220/440 AC	250 DC
75	G.E.	220/440 AC	125 DC
60	Allis Ch.	220/440 AC	250 DC
50	G.E. b.b. (3)	220/440 AC	250 DC
40	Ideal	220/440 AC	250 DC

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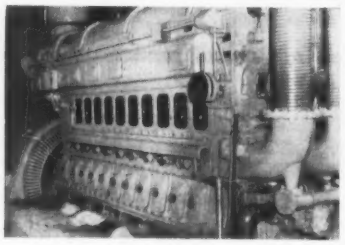
Big Savings from Manufacturer's price

1000kw FAIRBANKS-MORSE DIESEL ENGINE GENERATOR SETS



Remanufactured • Guaranteed

Any standard voltage.

Immediate delivery from stock.

A. G. SCHOONMAKER Company, Inc.

Foot of Spring St., Sausalito, Cal. Edgewater 2-1490

50 Church St., New York 7, N. Y. Digby 9-4351

LIQUIDATION

5—B & W 70,000# per hour Boilers, 500 psi, (1952)

1—I. R. Two Stage Compressor, type HHE-2, 3170 cfm, 125 psi, 600 HP motor. (1955)

1—I. R. Turbo Exhauster 15,360 cfm at 4.86 psi driven by 454 HP Moore Steam Turbine 125# steam, 6100 rpm, with I. R. two stage Barometric Condenser.

1—I. R. Turbo Exhauster 17,000 cfm at 4.15 psi driven by 678 HP G.E. Steam Turbine 125# steam, 4600 rpm with I. R. two stage Barometric Condenser.

200—Centrifugal Pumps with explosion proof motors, up to 9000 gpm.

WIRE PHONE WRITE

BRILL EQUIPMENT COMPANY
2401 Third Ave., New York 51, N. Y.
Tel. CYpress 2-5703

FOR SALE

1500 KW, 80% Power Factor, 3 phase, 60 cycle, 2300 volts, 3600 RPM, General Electric noncondensing steam turbine generator unit, 375 PSIG, 700° FTT, 125# exhaust back pressure, complete with direct connected shaft exciter and switchgear. Excellent condition—available immediate delivery.

EUCLID ENGINEERING CORPORATION

909 National City East Sixth Building

Cleveland 14, Ohio

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BOILERS — GENERATORS

C. R. CAMPBELL & CO. LTD.

3077 Bathurst St., Toronto 19

FOR SALE

2 CROSS COMPOUND — 750 KW WESTINGHOUSE 240 VOLT D.C. GENERATORS DRIVEN BY COMPOUND CORLISS ENGINES. ALSO 1—350 KW AND 1—500 KW, EACH COMPLETE WITH ALL STEAM ACCESSORIES, PIPING AND SWITCH GEAR, READY TO RUN.

FS-2409 POWER

520 N. MICHIGAN AVE., CHICAGO 11, ILL.

ELECTRICAL POWER EQUIPMENT

A. C. MOTORS—3 ph. 60 Cy.

SLIP RING

Qu.	HP	Make	Type	Volts	Speed
1	1750	G.E.	M-579BS	4800/2400	1800
1	1500	G.E.	MT-6	6600	1187
1	800	Whse.	CW	550	1776
1	600	Whse.	CW-432D-15	440	1778
1	500	Whse.	CW	550	350
1	300	G.E.	MTP-561	2300	1800
1	250	G.E.	MT-424Y	4000	257
1	250	Cr. Wh.	SIZE-290	2300	350
1	250	A.C.		550	600
1	250	Whse.	CW-1010	2200	435
1	200	G.E.	IM	2200	580
1	200	G.E.	IM	2200	435
2	200	Whse.	CW-890	2300	1775

SQUIRREL CAGE

2	550	Whse.	CS-1115	2300	900
1	500	G.E.	FT-559AY	2300	3600
4	500	Whse.	CS-1216	2200	500
3	500	G.E.	KF	2300	3600
2	450	Elliott	3916BB	2300	1200
2	400	Whse.	CS	6600/4000	3565
1	300	Whse.	CS-1002	2300	600
1	200	Whse.	CS-903H	2300	1175/878
1	200	G.E.	KT-357	440	1800
2	200	Whse.	CS-8558	220/440	1750

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	3500	G.E.	TS-6438P	2300/4000	360
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2100/1750	G.E.	514	250/350	2300/4600
1	2000	G.E.	514	660	2300/4600
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	514	250	6600/13200
1	1500	G.E.	600	600	2300/4150
1	1200	West.	720	600	2300/4160
1	1000	G.E.	900	260	6600
1	500	G.E.	900	250	2300/4600
1	500	G.E.	900	125/250	440
1	350	G.E.	900	125	440/4160
2	300	G.E.	1200	250	2300
1	300	Whse.	1200	600	2300
1	250	G.E.	900	250	220/440
1	240	West.	900	125	220/440
1	200	El. Mhy.	1200	250	2300/4600

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	300	G.E.	175/200# Cond. 480/2300 V.
1	1000	G.E.	150# no Cond 2400 V.
1	4000	G.E.	400# surface condenser 2400/4150 volts.

TRANSFORMERS

Qu.	KVA	Make	Type	PH.	Voltages
3	3333	Whse.	OISC	1	13800x2300
3	1000	G.E.	OISC	1	13800x460
2	750	G.E.	PYR.	1	55/255
2	500	Kuhl.	OISC	1	13200x6600
6	333	G.E.	OISC	1	7200/12470Yx2400/4160Y

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
1	5000	G.E.	60/50/60	11000/6600
2	2500	G.E.	25 cy/62.5	2300/2300

RE-NU-BILT BY

BELYEA COMPANY, INC.

43 Howell St., Jersey City 6, N. J.

Tel: OLDFIELD 3-3334

MODERN GE RECTIFIERS

3/60/13,200 AC to 600V. DC

4—1000KW Mod. 6RC-45-CD6

2— 500KW Mod. 6RG-45-CH2

Six Tube Ignitron Pump Type

Full Automatic AC & DC Controls

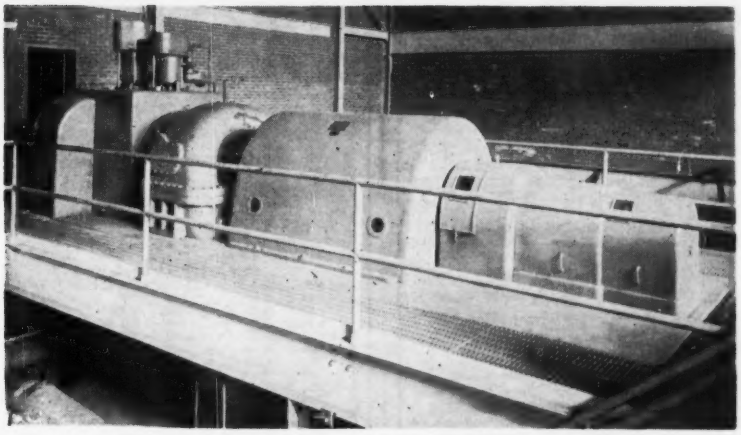
Can be inspected on original locations now in 1948, still like new, actual photos are available, very low price for lot.

S. M. DAVIS

525 N. 20th, E. St. Louis, Ill.

400 Lb. Pressure 750° G.E. Turbine Generators

CONDENSING — AUTOMATIC EXTRACTION



3125 KVA
Condensing 28" Vacuum

Automatic Extraction to 130 PSIG

Surface Condenser and Auxiliaries

General Electric Cubical Switchgear

New 1948 — Has operated less than three years.

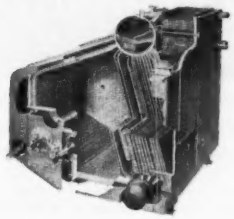
2—2000 KW G.E. 600# 750° N.C. 150# 4160V.
2—3000 KW G.E. 600# 750° N.C. 150# 4160V.
1—2500 KW G.E. 400# 750° Aut. Ext. 25# cond. 600V.
1—7500 KW West. 400# 750° Cond. 4160V.
1—2500 Allis Chalmers 400 Aut. Ext. 150 N.C. 30# 480V.
1—2500 West 125# N.C. 15# 2300V.

Cable Address: CHASWEAVER

CHARLES WEAVER, INC.
19701 JAMES COUZENS HIGHWAY
DETROIT 35, MICHIGAN

Telephone: BRoadway 3-1900

BOILERS NEW UNASSEMBLED



# Steam/hr.	Key	PSI	Temp.
122,500	DF	565	850
121,650	DF	565	850
60,000	SF	435	750
74,000	H	280	500
55,000	A	240	—

DF Double Furnace, SF Single Furnace (illustrated), bent water tube boilers w/economizers and superheaters, B & W's and Foster Wheelers.

H Header type, straight tube, B & W.

A 3 drum, single furnace, Wickes.

Pelnik-Loconti Industrial Supply, Inc.
315 Oriskany St., Yorkville, N.Y.
Utica, N. Y. Ph. RE 6-4621, RE 2-4513

GUARANTEED "REBUILT" POWER EQUIPMENT

SQUIRREL CAGE MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
1250	*Al.-Wh.	ANX	3600
600	West.	CS	720
600	*G.E.	K-63455	1200
500	*G.E.	K-63455	1200
500	*G.E.	I-13-E	900
350	*G.E.	KT-559-A	1800
300	*G.E.	K8344	1200
250	*W (TE)	CS-81205	1800
250	*G.E.	KT-509-S	1800
250	*West.	CS-875-S	1800
250	Brook	RS28	1200
200	*G.E.	FT-549	3600
200	*G.E.	I-K-13B	1800
200	West.	CSP-581-S	1800
200	Brook	RS-27	1200
200	*West.	CS-930-A	900
200	G.E.	KT-564-S	720
200	*Al.-Ch.	AN-37-G	720
200	*West.	CS-1010	600
200	Al.-Ch.	ARW-631	800
150	Cr-Wh.	SC-140	3600
150	Al.-Ch.	AN 30-F	1200
150	West.	CSP-5815	1200

M.G. SETS

Kilowatt	Make	Volts AC	Volts DC
1000	West.	4000	250
750	G.E.	4160	275
500	West.	440	250
400	Al. Ch.	2300	240
300	West.	2300	250
200	G.E.	2300	275
200	Ridgwy	2300	250
150	Al. Ch.	2300	275
150	West.	2300	250
125	Cr. Wh.	4150	125
125	G.E.	2300	250
100	G.E.	2300	250
100	Al. Ch.	2300	250
80	G.E.	220/440	250
40	G.E.	220/440	250

HUNDREDS OF BARGAINS
In
MOTORS, GENERATORS, CONTROL, HOISTS, COMPRESSORS, ETC.

SLIP RING MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
2500	*G.E.	MT (Mill Type)	257
1100	*G.E.	MT	720
1000	*G.E.	M-575-B	1200
1000	*West.	CW	450
600	*G.E.	M-6845-B	1800
500	G.E.	M-6845	1200
400	*G.E.	MTP-585	1200
350	*Al.-Ch.	ARYW	1800
300	Cr-Wh.	SR-78-R	1800
250	Al.-Ch.	ARY-828	1800
250	*G.E.	I-M-17A	720
200	G.E.	I-M-16	600
200	*West.	CW1950A	514
150	Cr-Wh.	SR-50R	1800
150	G.E.	I-M-15A	600
125	G.E.	I-M-15A	600
100	G.E.	I-E-13A	1800
100	G.E.	MT558	720
100	G.E.	I-M-15A	425
75	West.	CW-770	1200

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CHICAGO Electric Co.

ALL TYPES OF EQUIPMENT IN STOCK

1320 W. CERMAK RD. • CHICAGO 8, ILL. • PHONE: CANAL 6-3900

ONE BROWNELL, TYPE L F B

150 lb. pressure allowed per square inch. In good condition, passed regularly by State inspection. Measures 84" x 15'1" x 17'4½". Call Mr. Shipley.

SUN GLOW FURNITURE INDUSTRIES
Logan, Ohio — Phone EV 5-2615

BOILER

1—Keeler 200 HP, 160 psi, water-tube w/ stokers

COAL PULVERIZERS

1—Babcock & Wilcox #32E, 75 HP
1—Raymond 6-roll mill, 66" dia., 200 HP
3—Robinson #13 Sawtooth Crushers, 15 HP

COAL HANDLING CONVEYORS

4500'—16", & 24" all-steel trough rubber belt conveyor, complete units
150'-48" wide apron feeders

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PERRY EQUIPMENT CORP.
1422 N. 6th St., Philadelphia 22, Pa.
Phone: POplar 3-3505

1902 **COMPRESSORS** 1959

WORLD'S BEST REBUILTS

100 CFM 125 psi 6x7 Ing. ESI
188 CFM 100 psi 7x7 Ing. ES-I
162 CFM 125-500 psi 7½x13 Worth HB
180 CFM 60 psi 8x7 Ing. ES
184 CFM 135 psi 8x9 Ing. ES
236 CFM 100 psi 9x9 Worth. H. B. Ing. ES
280 CFM 500 psi 10-4¼x10 Ing.
290 CFM 75 psi 10x9 Ing. ES-I
311 CFM 1500 psi 10½-7½-3½x13 Ing. ES3
321 CFM 125 psi 10x11 Ing ES
400 CFM 100 psi 12x11 Ing.
502 CFM 125 psi 12x13 Worth HB
585 CFM 100 psi 15-9¼x12 Ing. XRE
628 CFM 100 psi 14x13 Ing ES
676 CFM 100 psi 15-9¼x12 Ing. XRB
1016 CFM 55 psi 17x13 Worth HB
1545 CFM 110 psi 21-13x14 Ing. XRE
7080 CFM 280 psi 33-17¾x27 IR PRE2 4C

AMERICAN AIR COMPRESSOR CORP.
Dell Ave. & 47th St. North Bergen, N. J.
UNion 5-4848

37 Years Dependable Service

SLIP RING MOTORS 3 Ph., 60 Cy.

H.P.	Volts	Make	Speed
500	4000/2300	G.E.	600
450	4000/2300	G.E.	1200
400	4000/2300	Whse.	720
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3600
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2200/440	G.E.	720
150	220/440	Whse.	720
125	2300	G.E.	600

AC GENERATORS or SYN MOTORS, 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2300	G.E.	TS	1800
400	2200/440	G.E.	ATI	720
300	440/220	G.E.	TS	450
300	2200/440	G.E.	TS	1200
200	440	G.E.	TS	600
150	440/220	Whse.	G	1200
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

500	2200/4000	Elliott	SC	1800
400	2300	G.E.	FT	3600
400	2300/4000	G.E.	K	1200
350	2300/4000	G.E.	SEDP	3600
350	2300/4000	G.E.	K	600
300(2)	2300	G.E.	FT	3600
300	2300/4000	L. Allis.	FS	1800
300	2300/440	G.E.	SEDP	1200
300	2300/4000	Cont'l.	Spl.-Prf.	720
300	2300/400	G.E.	KT	600
250	2300/4000	G.E.	K	720
200	2200	G.E.	KT	1800
200	2300	Cont.	TEFC	3600
150	440	Whse.	X-pf.	3600
150	440/220	Cont'l.	X-pf.	1800
150	440/220	G.E.	TEFC	720
150	2200/440		KT	600
150	2200/410	G.E.	FT	1200
125	2200/440	G.E.	K	600
100(2)	4000/2300	L. Allis.	OX	1200
100	2300	Cont'l.	TEFC	3600
60(2)	440	Cont'l.	X-pf.	1800

CIRCUIT BREAKERS, 3 Pole

4—1600 Amp., DA-50, Whse., 600 V., Air
1—600 Amp., Al. Chal., 15 KV, Outdoor
6— 600 Amp., R. Smith, 7.5 KV, Sol. oper.
1— 400 Amp., R. Smith, 7.5 KV, outdoor, New

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
150	230	El. Dyn.	H/brg.	800
60/75	220	G.E. (new)	CD	500/1500
50/60	230	Rel.	T	600/1800
50	230	G.E.(4)	CD	1150

MOTOR GENERATOR SETS

KW	Make	Input., AC	Motor Type	Output V., DC
300	Whse.	4150/400	Syn.	250/125
125	G.E.	440/220	Sq. Ca.	125
125	G.E.	440	Sq. Ca.	250/125
100	G.E.	2200/440	Syn.	250
75	Cr. Wh.	440/220	Sq. Ca.	240/120
70	El. Dyn.	440	Sq. Ca.	70
65	G. E. B	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—500 kva, Al Ch. 2400/4160Y—600 volts, 3 ph.
3—500 kva, G.E., 13800—2300 V.
3—500 kva, G.E., 13800—240/480 V.
3—333 kva, American, 2400—240/120 V.
1—200 kva, G.E., 2400—120/240 V., Pyr.
3—200 kva, Mol., 13,800—2300 V.
3—200 kva, G.E., 13,800—480 V.
3—200 kva, G.E. 4156—480/240 V.
3—167 kva, Whse., 4156—480 V.
3—150 kva, Al. Ch., 2400—220 V.
3—150 kva, G.E., 13,200—2300 V.
3—100 kva, Whse., 4800/2400-240/480 V., Dry
3—100 kva, G.E. 2400—120/240 V., Pyr.

GASOLINE—ENGINE GENERATOR SETS

2—35 kva, 900 R. 220 V, 3 ph. con. LeRoi, 6 cyl.
only partial listing

STEPHEN HALL & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	3000	Moloney	TCR	3	7200/6600-4160/2400
2	750	G.E.	K	1	4600-120/240
1	300	Penna.	(Askarel)	3	12470Y/7200-240
2	250	G.E.	H Pyranol	1	4800/3330Y/120/240
3	250	West.		1	2300/4600-230/460
3	200	G.E.	HSW2F	1	2400/4160-240/480
3	200	Al.-Ch.	CB	1	2400/4160-240/480
3	200	Amer.	CC	1	4160/72004-240/480
3	75	G.E.	KF	1	2400/4160-120/240
3	50	G.E.	H	1	2400/4160-240/120
1	50	Amer.	Abestol	3	4160-120/208Y
4	25	West.	Hypersil	1	2400/4160-120/240

MOTOR GENERATOR SETS

Qu	KW	Make	Speed	DC	AC
1	75	EM	1200	250	Syn. 220V.
1	75	G.E.	1200	125	2300/4160 Syn.
1	100	West.	1200	250	2300/4160Y Syn.
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y SR
1	300	G.E.	1200	250	440 Syn.
1	1000	West.	720	600	2300/4160Y

ENGINE GENERATOR SETS

1—Hercules Gas HXE 62.5 KVA Westghe 3/60/480—1200
1—Wisconsin Gas (Air) PE-99 7.5 KVA Master 1 or 3/120—2200 r.p.m.

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
2	40	West.	690	CW	220/440
1	60	G.E.	1800	MT	220
1	75	G.E.	600	TM	440
1	75	G.E.	1160	MT-547	440
1	100	West.	1800	T.F.F.C. B.B.	220
3	150	Allis-Ch.	1800	AY-RW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300
1	450	West.	1800	CW-4-30-9,	220 or 440
1	500	G.E.	450	MT	2200
1	500	G.E.	1200	M369Z	2300/4160Y

D. C. MOTORS—230 VOLTS

Qu	HP	Make	Speed	Type
1	350	G.E.	1200	Pedestal
1	92	West.	425/1000	SK 113
1	30	G.E.	1750	173 FR
1	30	West.	690/1400	SK-4G1543

SQUIRREL CAGE MOTORS, 3 PHASE, 60 CYC.

1—300 HP, 1200, Allis. Chalmers, 2300/4160Y
1—275 HP, 1130 RPM G.E. Type KT 559BS 2200V
2—200 HP, 1790 RPM, G.E. Elec. KF, TEFC, 2300V
1—100 HP, 1775 RPM G.E. KTP-543 3Ø 60-440V.

MOTORS—SYNCHRONOUS—3 ph. 60 cy.

100 HP 900 RPM G.E. Fom BL 2200 V.
125 HP 600 RPM G.E. Type TS 2200 V.
125 HP 900 RPM G.E. Type TS 4800 V.
150 HP 3600 RPM G.E. type TS Fr. 956Y 2200 V.
150 HP 1800 RPM G.E. Type TS 220 V.
300 HP 720 RPM Elec. Machinery t.e.f.c. 2300 V.
325 HP 900 RPM West—2300 V.
400 HP 450 RPM Westinghouse Type HR 440 V.

FOR POWER
J.L. HEMPHILL & CO.
1603 54th STREET, NORTH BERGEN, N. J.
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FOR SALE

E. Keeler Steam Generating Boiler CP Type

Rated 300-horsepower—will develop 23,000 pounds per hour.
2546 sq. ft. of heating surface
454 sq. ft. water wall heating surface.
160# maximum steam working pressure arranged for heavy oil firing.

Completely equipped with National Air Oil steam atomizing reverse firing burners, oil flow meter, gauges, reduced draft fan with stack, blowdown valves, dual oil preheater set with steam and electric fuel oil pumps, strainers, gauges steam pressure reducing valves etc.

Two steam boiler feed pumps (Union Steam Co.) either of which will develop full rating of boiler.

For further information contact Leon Herzfeld, Esq.

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AUTOMATIC and MANUAL
Gas or DIESEL GENERATOR UNITS
Complete Switchboard Design and Construction
USED & REBUILT EQUIPMENT
UNIVERSAL POWER ENGINEERING CO.
382 Wayne St. Jersey City, N. J.
Phone: DElaware 2-8300

POWER EQUIPMENT

7500 KW West. Cond. Turbo-Gens. (2) 3 ph., 60 cy., 4160 V, 3600 RPM 400 PSI, 750°, D.C. exciter
1000 KW Worth-Moore Cond Ext Turbine 3/60 245/490V 130-300#IP,10#Ext
700 KW G.M. 12-567 Diesel Units (4) 3 ph., 60 cycle, 480/2400 V
150 KW General Motors Diesel Units 3/60 220/440V 1800 RPM - (3)

BREW, WOLTMAN & CO., INC.
50 Church Street, New York 7, N. Y.

BOILER FOR SALE

One B & W Integral Furnace FF-16 No. 48. Designed pressure 225 psi, oil, gas tar or natural gas fired, rated 45,000#/hr. at 135 psi. Complete accessories inclucing soot blowers, burners, fans, control panel, oil heaters, connecting valves, nozzle cleaning bench, etc. For additional information pertaining to detailed description, terms of sale and location call or write

LONG ISLAND LIGHTING COMPANY
175 Old Country Road, Hicksville, New York
Attention of Mr. S. L. Koslow

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1—Worthington 2" Pump—60 GPM @ 350'—25 HP Motor—440 volts-3 Phase-60 cycle
1—Dayton-Dowd Pump—83 GPM @ 397'—Motor Drive—440 volts-3 Phase-60 cycle
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Advertisers' Index

A

ACF Industries, Inc.
W-K-M Division 199
Aerotec Industries, Inc. 306
Air Preheater Corp. 37, 311
Allen-Sherman-Hoff Co. ..... •
Allgemeine Elektricitats-Gesellschaft
Second Cover
Allis-Chalmers Mfg. Co. 243, 245, 247
Allis-Chalmers Mfg. Co.
Hydraulic Div. ..... •
Allpax Company, Inc. 251
Alpha-Molykote Corp. ..... •
Aluminum Co. of America 191-192-193-194
American Brass Co. 63
American Engineering Co. ..... •
American Gilsonite 315
American Hard Rubber Co. ..... •
American Meter Co.,
Pump Div. 314
American Pulverizer Co. 272
American Standard
Industrial Div. 50-51
Ames Iron Works ..... •
Anchor Packing Co. 43
Annin Company 64
Armstrong Machine Works 162
Asea Electric, Inc. ..... •
Associated Research Inc. 292
Atomics International
Div. of North American Aviation ..... •
Avondale Marine Ways, Inc. 141

B

B-I-F Industries, Inc. ..... •
Babbitt Steam Specialty Co. 322
Babcock & Wilcox Co.
Boiler Div. 4-5, 126-127, 265
Babcock & Wilcox Co.
Tubular Products Div. 158
Babcock & Wilcox Co.
Tubular Products Div., Fittings Dept. ..... •
Badger Mfg. Co. 140
Bailey Meter Company 10-11
Baldwin-Ehret-Hill, Inc. ..... •
Baltimore & Ohio Railroad ..... •
Barnes & Jones, Inc. 254
Basnik Co., Vince ..... •
Belmont Packing & Rubber Co. ..... •
Biddle Co., James G. ..... •
Bingham Pump Co. 143
Bituminous Coal Institute 224-225
Black, Sivalls & Bryson, Inc. ..... •
Blackmer Pump Co. 290
Blaw-Knox Company
Equipment Div. ..... Third Cover
Blaw-Knox Company
Power Piping Div. 68
Boiler Engineering & Supply Co. ..... •
Boiler Tube Co. of America ..... •
Bonney Forge & Tool Works ..... •
Borg-Warner Mechanical Seals
Div. of Borg-Warner Corp. ..... •
Bridgeport Brass Co. 134
Brown Boveri Corp. 273
Buell Engineering Co. 242
Buensod-Stacey Co. 207
Buffalo Forge Co. 202
Buffalo Pumps
Div. of Buffalo Forge Co. ..... •
Bussmann Mfg. Div.
McGraw-Edison Co. 76-77
Butler Mfg. Company 327

C

Capitol Pipe & Steel Products, Inc. 291
Carling Turbine Blower Co. ..... •
Carpenter Steel Co.
Alloy Tube Div. ..... •
Catawissa Valve & Fittings Co. ..... •
Chase Brass & Copper Co. 214
Chemtrol 325
Chesterton Co., A. W. 304
Chicago Pneumatic Tool Co. 40-41
Clarage Fan Co. 135
Clark Bros. Co.
One of the Dresser Industries 215
Cleaver-Brooks Co., Boiler Div. 252
Cochrane Corporation 18-19
Coen Company ..... •
Coffin Turbo Pump Co. 299
Combustion Engineering, Inc. 46-47
Condenser Service & Engrg. Co. 300
Cooper-Bessemer Corp. 204-205
Copes-Vulcan Div.,
Blaw-Knox Company 12-13
Coppus Engineering Corp. 223
Corning Glass Works ..... •
Crane Company 33-34-35-36, 125
Crane Packing Co. 289
Crawford Fitting Co. 137
Curtiss-Wright Corp. ..... •
Metals Processing Div. ..... •
Cyclotherm
Div. of National-U.S. Radiator Corp. 55

D

Daystrom Systems
Div. of Daystrom, Inc. ..... •
DeLaval Steam Turbine Co. 198
Detroit Controls
Div. of American Standard ..... •
Detroit Stoker Company 38
Diamond Power Specialty Corp. 6-7
Dodge Mfg. Corp. 147
Dow Chemical Co. 149
Dow Corning Corp. ..... •
Dowell ..... •
DuPont de Nemours & Co., Inc., E. I. 271

E

Eagle-Picher Co. 26
Edward Valves, Inc. 22-23
Electric Machinery Mfg. Co. 200-201
Electric Storage Battery Co.
Exide Industrial Div. 28
Elgin Softener Corp. ..... •
Elliott Company 14-15
Elliott Company—Lagonda Plant ..... •
Elliott Company—Roto Plant ..... •
Emhart Mfg. Company
Maxim Div. 326
Engineer Company 264
Erie City Iron Works 144-145

F

Fairbanks Company 298
Fibreboard Paper Products Corp.
Pabco Ind. Installations Div. ..... •
Fisher Governor Co. 156-157, 320
Flexitallic Gasket Co. 69
Fluor Products Co. ..... •
Fly Ash Arrestor Corp. 258
Foster Company, Benjamin ..... •
Foster Wheeler Corp. 66-67, 295
Foxboro Company 30
Frick Company ..... •
Fuller Company 262

G

Garlock Packing Company 58-59
General Controls 257
General Electric Co. 27, 48-49, 226
Goulds Pumps, Inc. ..... •
Green Fuel Economizer Co. 146
Grinnell Company 212-213
Griscom-Russell Co. 138

H

Hagan Chemical & Controls, Inc. 53-54
Hall Laboratories ..... •
Hamon, Inc. 317
Harbison-Walker Refractories Co. ..... •
Heyl & Patterson, Inc. 31
Hooper Printing & Lithograph Co. ..... •
Hungerford & Terry, Inc. 324
Hupp Aviation Company
Electrodyne Div. ..... •

I

I-T-E Circuit Breaker Co. ..... •
Illinois Water Treatment Co. ..... •
Infilco Inc. 267
Ingersoll-Rand Co. 25, 255
International Boiler Works Co. ..... •
International Nickel Co., Inc.
Huntington Alloy Products Div. 338
International Register Co.
Instrument Div. 319
Iron Fireman Mfg. Co. ..... •

J

Jenkins Bros. 8-9
Jerguson Gage & Valve Co. 268
Johns-Manville 20-21
Johnson Service Co. 56-57

K

Kaiser Aluminum & Chemical Sales, Inc. 151
Kato Engineering Co. 298
Keasbey & Mattison Co. 218-219
Keeler Co., E. 150
Kennedy Valve Mfg. Co. 302
Kennedy-Van Saun Mfg. & Engrg. Corp. 269
Kerrigan Iron Works Co. 290
Kieley & Mueller, Inc. 128
Kinney Engineers, Inc., S. P. 322
Kirk & Blum Mfg. Co. 260
Klipfel Valves, Inc. ..... •
Koppers Co., Inc.
Coupling Dept. 222
Koppers Co., Inc.
Electrostatic Precipitators ..... •

L

Laclede Stoker Co. ..... •
Leslie Company 216-217
Limitorque Corp. ..... •
Link-Belt Company 1
Liquidometer Corp. ..... •
Lunkenheimer Company ..... •

M

Manning, Maxwell & Moore 42, 152
Marley Company 60
Marsh Instrument Company
Div. of Colorado Oil & Gas Corp. ..... •
Mason-Neilan
Div. of Worthington Corp. 132-133
McDonnell & Miller, Inc. 288
McGraw-Hill Book Co. 286, 323
McNally Pittsburg Mfg. Corp. 253
Mears Kane Ofeldt, Inc. 286
Mercoid Corp. ..... •
Minneapolis-Honeywell 24
Murray Iron Works Co. 32
Murray Mfg. Co., D. J. 270

This index is a service to readers. Every effort is made to maintain its accuracy, but POWER cannot assume responsibility for errors or omissions. When a star appears after the name, the advertisement does not appear in this issue but appeared in an issue within the previous three months.

N

Nalco Chemical Co. 303
National Airol Burner Co., Inc. ..... *
National Conveyors Co., Inc. 62
National Electric Coil 249
National Tube
Div. of U.S. Steel 39
Niagara Blower Co. 322
Nicholson & Co., W. H. ..... *
Nordberg Mfg. Co. 305
Norfolk & Western Railway 136

O

Ohio Brass Company ..... *

P

Pacific Pumps, Inc. 210-211
Panellit, Inc. ..... *
Patterson-Kelley Co. ..... *
Peabody Engineering Corp. ..... *
Peerless Pump Div.
Food Machy. & Chemical Corp. ..... *
Pennsylvania Pump & Compressor Co. ... 316
Pfaudler Permutit, Inc. 318
Pfizer & Co., Inc., Charles
Chemical Sales Div. 287
Phelps-Dodge Copper Products Corp. 44-45
Philadelphia Gear Corp. 195
Phoenix Mfg. Co. ..... *
Pioneer Service & Engrg. Co. 250
Pipe Fabrication Institute ..... *
Pittsburgh Piping & Equipment Co. ..... *
Porter Co., Inc., H. K.
Forge & Fittings Div. 206
Powell Co., Wm. 142
Pratt Co., Henry 294
Pritchard & Co., J. F. ..... *

R

R-P & C Valve Div.,
Amer. Chain & Cable Co., Inc. 248
Raybestos-Manhattan, Inc.
Manhattan Rubber Div. 196-197
Raybestos-Manhattan, Inc.
Packing Div. 244
Reliance Gauge Column Co. 240
Republic Flow Meters Co. 70
Republic Steel Corp.
Steel & Tubes Div. 154-155
Research-Cottrell, Inc. 129
Ridge Tool Company 301
Riley Stoker Corporation 160-161
Robertshaw-Fulton Controls Co.
Aeronautical & Instruments Div. ..... *
Rockwell Mfg. Co.
Nordstrom Valve Div. 209
Rohm & Haas Co. 73

S

Sarco Company, Inc. 293
Scam Instrument Corp. 292
Schaub Engineering Co., Fred H. 312
Schoonmaker Co., Inc., A. G. ..... *
Scovill Mfg. Co. 261
Smith Corp., A. O. ..... *
Spence Engineering Co. ..... *
Standard Oil Co. of Indiana 153
Stephens-Adamson Mfg. Co. ..... *
Stickle Steam Specialties Co. 268
Stock Equipment Co. 130-131
Stow Manufacturing Co. 266
Strong, Carlisle & Hammond 61
Superior Combustion Industries, Inc. 239

T

Terry Steam Turbine Co. 65
Texaco, Inc. ..... *
Titusville Iron Works Co.
Div. of Struthers-Wells ..... *
Todd Shipyards Corp.
Products Div. 320

U

Union Asbestos & Rubber Co. ..... *
Union Iron Works ..... *
U.S. Electrical Motors, Inc. 52
United States Gauge 313
United States Motors Corp. ..... *
Universal Atlas Cement
Div. of U. S. Steel ..... *

V

Valley Camp Coal Co. 241
Viking Pump Co. ..... *
Virginia Gear & Machine Corp. 195
Vogt Machine Co., Henry 74

W

Wallace & Tiernan, Inc. 256
Walworth Company 263
Warren Pumps, Inc. 321
Webster Manufacturing, Inc. 246
Western Chemical Co. ..... *
Western Precipitation Corp. 148
Westinghouse Electric Corp. 78, 259, 274
Wheeler Mfg. Co., C. H. 208
Where to Buy 328
Whiton Machine Co. 296
Wickes Boiler Co. ..... *
Wiedeke Co., Gustav 270
Wolverine Tube
Div. of Calumet & Hecla, Inc. 29
Worthington Corp. ..... 71-72, Back Cover
Wright-Austin Company 297

Y

Yarnall-Waring Company 16-17, 284, 285

Z

Zallea Brothers 203
Ziegler & Co., G. S. 139
Zimmerman Packing Co. 292

Professional Services 328

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 329

EQUIPMENT
(Used or Surplus New)
For Sale 329-335

WANTED
Equipment 329

ADVERTISERS INDEX

Ajax Electric Motor Corp. 329
Allied Electric & Machinery Co. 329
American Air Compressor Corp. 333
Angelina County Lumber Co. 329
Arg Chemical Machinery, S.A. 329

Barnes & Jones Inc. 329
Belyea Co., Inc. 330, 332
Benson-Wilimzig Inc. 335
Boiler & Equipment Co., Inc. 334
Boston Metals Co. 330-331
Boyay Jr., H. E. 329
Brew, Woltman & Co., Inc. 334
Brill Equipment Co. 332

Campbell & Co., Ltd., C. R. 332
Canton Municipal Utilities 329
Chicago Electric Co. 333

Davis, M. Samuel 332
Deere & Co. 335
DeRose, G. M. 335

Ebasco Services, Inc. 329-335
Erie Electric Co., Inc. 330
Euclid Engineering Corp. 332

Foster Co., L. B. 330

Hall & Co., Stephen 334
Heat & Power Co., Inc. 336
Hemphill & Co., J. L. 334
Herman Machinery & Supply Co. 329
Herzfeld Esq., Leon 324

International Power Machinery Co. 335

Long Island Lighting Co. 334

Machinery Expediters 335
Midwest Boiler & Turbine Co. 330

Pelnik-Loconti Industrial Supply Co. 333
Perry Equipment Corp. 333
Power Equipment Co. 330

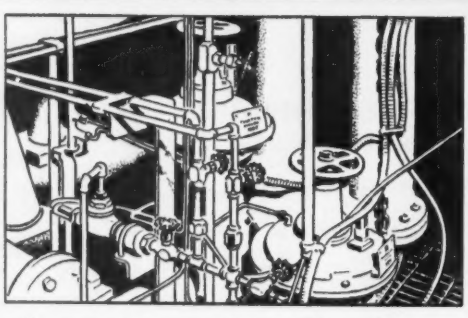
Schoonmaker Co., Inc., A. G. 332-335
Sun Glow Furniture Industries 333

Universal Power Engineering Co. 334

Wabash Power Equipment Co. 330
Wagner Co., Arthur 332
Weaver, Charles 333
Whisler Equipment Co. 335

Where metal costs less than plain water

SALTY, SANDY WATER IN CIRCULATION PUMP GLAND SEALS AT A COASTAL POWER PLANT CUT SHAFT SLEEVE LIFE BELOW 2½ YRS. USE OF FRESH WATER IN PACKING GLANDS WOULD HAVE REDUCED ABRASION, CORROSION. BUT THERE WAS A CHEAPER WAY. "S" MONEL* HARD-GRADE NICKEL-COPPER ALLOY SLEEVES, PRODUCED AT INCO'S BAYONNE FOUNDRY, WERE INSTALLED. NOW IN SERVICE 4 YEARS ...NO REPLACEMENTS...THE COST OF "S" MONEL SLEEVES WAS LESS THAN THE ESTIMATED COST OF PROVIDING FRESH WATER FOR LUBRICATION.



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IT TAKES A MAZE OF SMALL TUBES TO PICK UP SAMPLES OF TREATED WATER, CAUSTIC SODA, AND WATER RINSES FROM AN ANION EXCHANGER. BECAUSE OF A CONSTANT CORROSION PROBLEM CAUSED BY ACID REGENERATION, MONEL ALLOY IS USED FOR THE TUBES, FITTINGS, AND FIXTURES THROUGHOUT THE SAMPLING SYSTEM OF AN EASTERN POWER PLANT'S NEW ION EXCHANGE SYSTEM.

SLOWED DOWN BY A METAL PROBLEM?

A TALK WITH ENGINEERS FROM INCO'S MECHANICAL ENGINEERING SECTION MAY HELP YOU GET BACK ON SCHEDULE. JUST GET IN TOUCH WITH US AND OUTLINE THE DETAILS. AND FOR A USEFUL RUN-DOWN ON MONEL ALLOY, WRITE DEPARTMENT **P** FOR 30-PAGE INCO BULLETIN, "ENGINEERING PROPERTIES OF MONEL AND 'R' MONEL ALLOYS."

Alloy Plugs for leaky heat exchanger tubes put an end to galvanic corrosion, too

PLUG'S SHAPE PREVENTS TUBE SHEET DAMAGE, MAKES CERTAIN PLUG IS DRIVEN IN CONCENTRIC WITH TUBE. OF MONEL* NICKEL-COPPER AND INCONEL* NICKEL-CHROMIUM ALLOYS, PLUGS ARE CORROSION-RESISTING AND GALVANICALLY COMPATIBLE WITH HEAT EXCHANGER TUBE MATERIAL.

*Inco trademark

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The International Nickel Company, Inc.
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INCO ALLOY PRODUCTS
TRADE MARK

For more facts circle 971 on Reader Service card, p 227

For that extra margin of Safety . . .

Specify Blaw-Knox Electroforged® Steel Grating and Treads

Men working around cars on a trestle must have sure footing in any weather. Blaw-Knox Electroforged Steel Grating with its non-slip twisted crossbar provides a walking surface that is safe and clean. Snow does not pile up and freeze, and rain cannot form puddles. Spillover from cars falls through, making frequent cleaning unnecessary.

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One-piece construction cuts easily to fit neatly around pipes and beams. No alteration of existing structures is required.

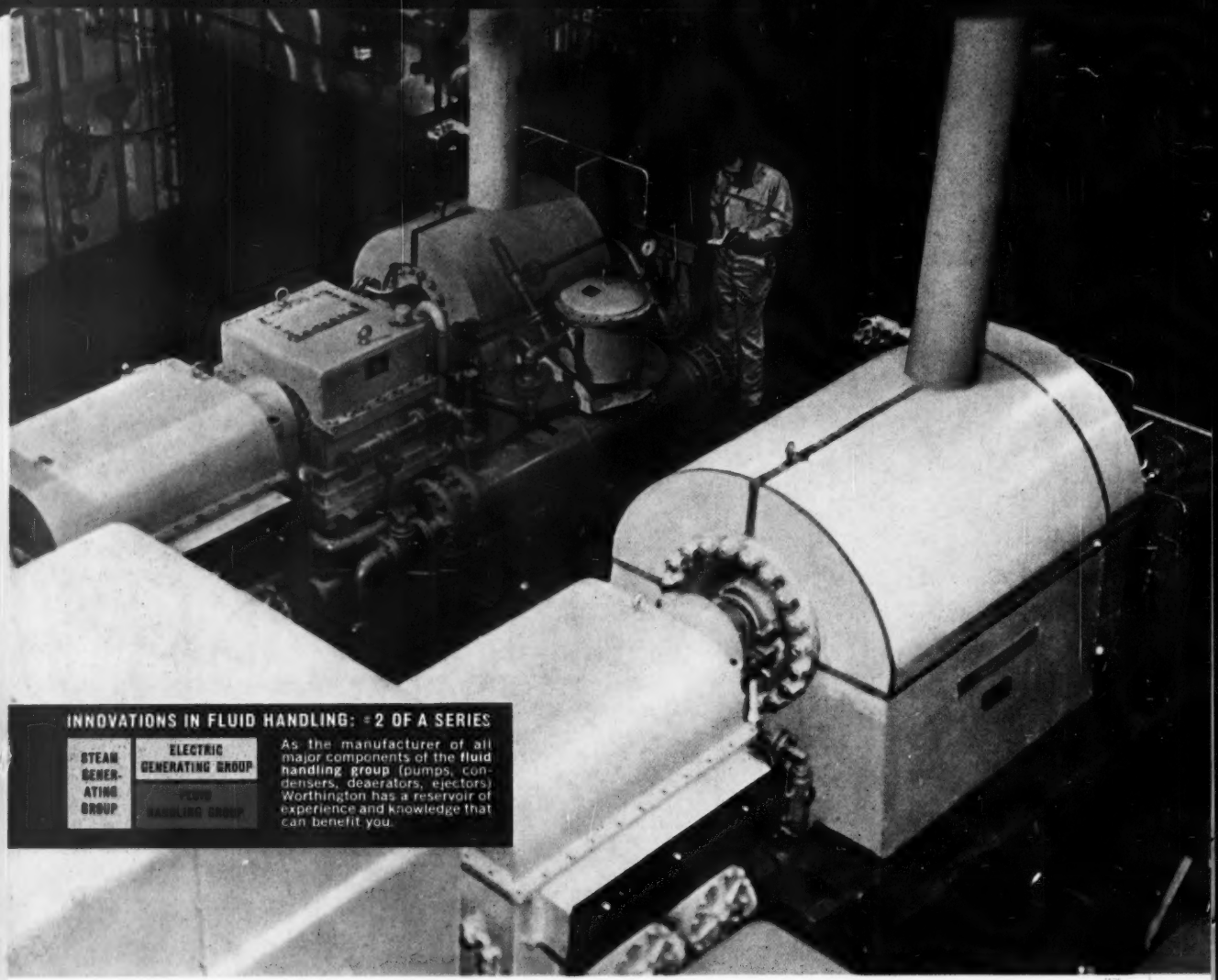
For information on how to specify the Blaw-Knox Electroforged Steel Grating best suited to your needs, write for your copy of Bulletin 2527-R.

BLAW-KNOX COMPANY

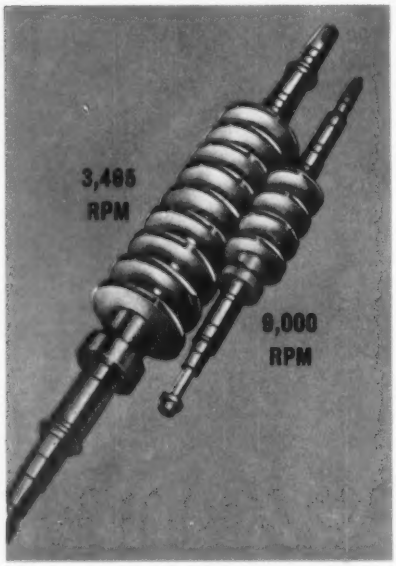
BLAW-KNOX

Blaw-Knox Equipment Division
Dept. Y, Pittsburgh 38, Pa.

For more facts circle 777 on Reader Service card, p 227


INNOVATIONS IN FLUID HANDLING: #2 OF A SERIES
STEAM GENERATING GROUP
ELECTRIC GENERATING GROUP
FLUID HANDLING GROUP
As the manufacturer of all major components of the fluid handling group (pumps, condensers, deaerators, ejectors) Worthington has a reservoir of experience and knowledge that can benefit you.

This photo measures pump progress. Here are two boiler feed pumps with duplicate pressure and capacity ratings. On the right is a unit of conventional speed; the other is the fastest pump of its type in service, running at 9,000 rpm. Smaller size is dramatically evident.



Comparison of rotors. The rotors used in the two pumps above are shown here. The 4-stage rotor used in the high speed pump will have one-third the deflection of the 9-stage rotor in the conventional unit.

PUMP PARADOX

High speed boiler feed pumps are several times as fast, yet actually more reliable

In modern power plants, the demand for higher efficiency has led to higher operating pressures and, therefore, higher heads for boiler feed pumps. This is a critical area for the fluid handling group. Can you obtain these higher heads without sacrificing reliability?

Worthington has proved that you can. By going to speeds twice as fast (and even greater) Worthington drastically reduces shaft spans required. This cuts shaft deflection to a fraction of its former value. Since pump wear, and hence pump life, is directly related to shaft deflection, the high speed pump is actually more reliable than a conventional unit of the same capacity.

Experience in the field has proved the wisdom of Worthington's design philosophy. More than 39 Worthington high speed pumps are now installed and 21 are on order. Speeds range from 6,500 to 9,000 rpm. If necessary, Worthington sees no reason why speeds shouldn't go even higher, without departing from experience-proved construction principles.

Reducing shaft deflection through shorter shaft span is only one way that Worthington increases boiler feed pump reliability. Other ways include larger shaft diameters, liberal clearances, shrunk on impellers, metal-to-metal pressure joints, a special method for measuring internal wear, and anti-oil-whip bearings.

High speed boiler feed pumps are one example of Worthington's leadership in the fluid handling area. Through the years Worthington has made many contributions to the solution of power plant problems. Why not put this progressive "know how" to work on your next plant? Worthington Corp., Harrison, N. J. In Canada: Worthington (Canada) Ltd., Brantford, Ontario.

45-6

WORTHINGTON